CHAPTERS IN THE PREHISTORY OF EASTERN ARIZONA, III

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JAMES N. HILL

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Map showing eastern Arizona and western New Mexico.

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I. Introduction

Location

Excavations in 1963 were undertaken at Broken K Site, about 10 miles east of Snowflake, Arizona (Frontispiece). The ruin is on the ranch of Mr. James Carter whose brand mark we adopted for the name of the site. It is located near the banks of Hay Hollow Wash, a tributary of Silver Creek and of the Little Colorado River, in the southwest quarter of the northeast quarter of Section 8, Township 13 North, Range 23 East, Gila and Salt River Meridian; in longitude 109°33′ N. The elevation is about 5760 feet above sea level (pocket altimeter).

The research reported herein was made possible by a grant from the National Science Foundation (G22028) and by financial assistance from the Field Museum.

Statistical analyses, including cost of computer time, (Chapters III, VII) were paid for by a grant (1524) that the Wenner-Gren Foundation for Anthropological Research made to the Museum. Without this support, the statistical handling of the data would not have been done. We are deeply grateful for this assistance.

Financial aid from Mr. C. E. Gurley, Gallup, New Mexico; Mr. Maxwell Hahn, Scarsdale, New York; Mr. Ed Alexander and Mr. Judd Sackheim, Chicago, is acknowledged with thanks.

The work reported here was conducted between 1 July and 20 September, 1963, although preliminary digging was done in September, 1962, under the supervision of Dr. John B. Rinaldo. Excavations were supervised by John M. Fritz and James N. Hill, doctoral students, University of Chicago. They were assisted by student-trainees: Dennis DeWitt, Tulane University; David Harper, Rocky Mountain School; Nels Johnson, Fenger High School, Chicago; and Paul Boyer, University of Illinois. Students receiving compensation were: Tom Marks, Highland Park High School; Anna Rose and Mark Sconce, Antioch College, Yellow Springs, Ohio.

In addition to the students, we employed several men who have dug for us in other seasons: James Brinkerhoff, Libor Garcia, Celedonio Griego, Elias Padilla, Guillermo Padilla, Gilbert Padilla, Lee Padilla, Porfirio Padilla, Ned Saiz, and Joe Velasquez.

All of these people, under the able direction of Messrs. Fritz and Hill, dug with vigor, interest, and intelligent cooperation. They followed natural levels, sifted, and trowelled with care. A tremendous amount of dirt was moved. I am happy to thank those co-workers and to salute them for a job well done.

Surroundings

The region about the pueblo of Broken K is a gently rolling plateau broken just east of the site by Point of the Mountain, a tongue of lava that rises about 500 feet above the plain. The White Mountains lie about 40 miles to the south.

The surface of the plateau-mesa near the site has been badly eroded by overgrazing and high winds. Arroyos, dry most of the time, become swift-running destructive streams after rains. Junipers occur but are stunted; grass is sparse and chenopods and amaranths abound. In brief, the area is bleak, dreary, and uninviting.

Climate

Annual precipitation is meager and is probably the same as that which falls on Snowflake, Arizona, where weather records have been kept since 1898.

The mean annual precipitation for Snowflake is about 12 inches; the mean annual temperature is 51.4° F.; with a mean annual maximum of 69.5° F. and a mean annual minimum of 33.2° F. Temperatures range from 102° to a minus 24° F. The average number of frost-free days is 133, eight years of which (between 1898 and 1930) produced a growing season of less than 120 days. The heaviest rainfall (1898–1930) is in July (2.39 inches average) and in August (2.57 inches average).

To obtain a crop of corn, one must consider not only the frost-free days but also such items as night temperatures and ground moisture in May and June and the time of the onset of summer rains. I would judge from the weather records at hand that the average conditions today are unfavorable for growing corn.

If the same conditions existed during the occupancy of Broken K Pueblo, or during any part of its life span, the Indians may have been unable to produce a crop every year; and if several consecutive dry years occurred, their supply of viable seed corn may have diminished and eventually have been reduced to the danger point.

Geology

The geological features of the area have not been intensively studied. The sandstone underlying and near the ruin is of the Moenkopi formation,

of the Triassic period. About a mile to the east lies a great tongue of lava (basalt) that juts northwestward from the main lava field. This tongue overlies rocks belonging to the Chinle formation, also Triassic. The site rests on bedrock of sandstone.

Appearance of Ruin Before Excavation

Broken K site was discovered by Dr. William A. Longacre during the course of our archaeological survey in 1961–1962 (Martin, Rinaldo, Longacre, *et al.*, 1962). It is composed of four house-blocks or groups of contiguous rooms that are organized in the form of a large rectangle enclosing an open plaza. Entrance to the plaza was by means of a passageway located in the southeast corner of the pueblo. Nowhere were the mounds making up the four-room blocks more than three or four feet above the surrounding terrain.

Method of Excavation

I did not have enough money to dig the entire ruin. It was decided, therefore, to utilize a systematic technique of sampling in order to obtain a statistically random sample.

We first exposed all principal walls and crosswalls of all rooms. Ninety-two rooms were thus outlined and assigned consecutive numbers. No circular depressions were noted.

We decided that we should excavate at least 50 per cent of the rooms in order to obtain an adequate sample. To obtain a random sample we selected 46 numbers from a table of random digits; or, in other words, the 46 rooms that were destined to be dug. (For complete discussion of sampling, see Chap. VI.)

Data recovered in this manner allow confidence limits of greater than 90 per cent for ensuring a representative sample of the universe of rooms and artifacts. Dirt was removed by natural levels and all culturally significant levels were screened. Everything, except dirt and stray pebbles, was saved, processed, catalogued, and tabulated. This included: lithic waste (stone chips with and without "use" flaking), tools of stone and bone, animal bones, beads, potsherds, wood, charcoal, seeds, nuts, and human dung. Only cultural debris found directly on the floors of rooms were called "floor materials."

In addition to the basic sample (46 rooms), we dug seven more pueblo rooms, two subterranean kivas, and three outlying rooms, making a total of 58 units. During the course of excavations we encountered two other subterranean kivas (one under room 22 and one under room 39); several

pit houses that may be dated as Forestdale Phase (circa A.D. 600–800) (Haury, 1940); and in the southwest corner of the plaza, a chamber cut into bed rock. The function of the latter structure is unknown, although it resembles an unfinished Kiva.

Evolution of Pueblo Architecture

The quadrilateral arrangement of rooms with plaza represents the final step in a long tradition of building sequences that we have observed. Earlier pueblos in the Pine Lawn-Reserve areas, as well as in the present area, usually consisted of four to ten rooms strung out along one axis. Later pueblos were constructed in the shape of a squarish U, often with a kiva or kivas located between the arms of the U. Still later pueblos clung to the U pattern but many more rooms were crammed into this honey-comb-like arrangement. The culmination of this tradition is represented in the Broken K Site where the U becomes a rectangle with a small entry-way at one corner.

The rise or invention of a row of contiguous rooms, with walls of poles and brush and later of cut and shaped stones was a new combination or synthesis of elements in the inter-active development of culture. The occurrence of a communal house of several rooms took place in the Southwest because the circumstances of culture growth and history in the early centuries of the Christian era brought together the elements necessary to this type of building in the Southwest. The pueblo building was an adaptive response to the total social and ecological environment.

It is possible that this evolutionary aspect of pueblo architecture (that is, from pit houses to surface, contiguous stone-walled clusters of rooms arranged in a cellular fashion), may be the result of indirect interaction with the higher cultures to the south (the highlands of Mexico) in response to a need. Then, this house building was pushed to new and different evolutionary heights that bore no resemblances to the borrowed prototype. In other words, the borrowed architectural form was reworked, modified to fit the social and ecological milieu, and adapted to the particular needs of Southwestern cultural systems.

On the other hand, it must be admitted that this form of architectural adaptation to Southwestern cultural environment may have been an independent development. A rather good case could be made for this latter point of view but actually not enough evidence is at hand at the moment to pass judgment on these matters.

The total social and ecological environment that produced the cultural advance from pit houses to complex aggregates of rooms formally arranged around a plaza is not known with certainty. But there is no doubt that

pueblo architecture was a technological discovery brought about by the fact that the culture processes had reached a point where such a discovery was possible and probably inevitable.

If we view culture as an organized, integrated system composed of aspects or subdivisions, we can distinguish three sub-systems: technological, sociological and ideological. They are inter-related but the influence of this reciprocal interaction is not equal. Technology plays the primary role.

Architecture must be viewed in two cultural contexts: technomic, for it deals directly with environmental problems, and socio-technic, for it reflects the social relationships of the culture. In the case of pueblo houses, seen technomically, the builders probably discovered that houses with contiguous walls of stone were more efficient and easier to build, gave better protection from winds and cold weather, served as better places for storing and preserving foods, and were useful as protection from unfriendly peoples. Within this technomic framework, architecture was probably modified to fit the sociological structure which was evolving, but, remembering that culture is a system of interdependant variables (technology, sociology, ideology), there can be no doubt that the sociology was also modified to fit the architectural changes. The question of the extent of these sociological changes is moot.

Thus we abandon the explanations that invoke "coincidence", the "achievement of a genius", "migrations" or other whimsical ideas. When certain factors and conditions are present and in conjunction, an invention or discovery takes place; when they are not present, the invention or discovery does not take place. (White, 1949, p. 209).

Hence, I can say that the invention of pueblo architecture (contiguous rooms, stone walls, several terraced stories) came about because the right ecological, technological, economic, and sociological factors and conditions were present and in association or conjunction.

Problems

One of the prime problems of the research on Broken K was to demonstrate that archaeology can be raised to the explanatory level by using recent advances in methodology and by adopting a more useful concept of culture. We focused our attention on cultural structure and processes instead of on taxonomy and trait lists. We have combined some traditional methods with newer sampling procedures and with data-processing by computer.

Hence, we were determined to make a contribution to the growing corpus of anthropological knowledge and theory; to augment our knowl-

edge of some of the cultural processes that took place in the prehistoric Southwest; and to demonstrate that the complex inter-relationships of people, places, and artifacts of prehistoric sites can be better understood through the use of diverse forms of statistical analyses.

We expected to make several primary contributions to knowledge:

1. a unique sociological analysis of a prehistoric site in the Southwest;

2. an important gain in our knowledge of the origins and causes of contemporary social organization of the Pueblo Indians;

3. a demonstration of the use of the powerful tools provided by statistical techniques and data-processing computers;

4. the value of a number of other research techniques for implementing such goals as have been outlined here—notably involving the utilization of other disciplines, such as palynology (Botany) and Zoology.

Note: This Volume includes the traditional treatment and descriptions of architecture, and bone and stone tools, and a listing of pottery types with a table showing gross frequencies by types. For interested persons these data may be used for comparative studies.

The descriptions of the stone and bone tools by Longacre have been tightened, clarified, and refined; and the types are treated functionally. In addition, far-reaching and unique creative deductions have been drawn from distributions, densities, and associations. Detailed counts, measurements, and find-spots are published in Archives of Archaeology, Martin, Longacre, and Hill, 1966, no. 27.

The companion volume by James N. Hill, (Broken K: A Prehistoric Society in Eastern Arizona, in press) presents all of the data used in testing the hypothesis that Broken K Pueblo represents an adaptive stage in the evolution of contemporary Pueblo social organization. These data include identification of (1) types of "areas" (work, storage, habitation, ceremonial) and functions carried on there; of (2) the loci of uxorilocal descent groups; of (3) the loci households; as well as analyses of social organization and social processes, and of environmental deterioration as indicated by palynological evidence. Statistical methods that were employed for perceiving associations and for testing hypotheses and inferences will be given.

Paul S. Martin

June, 1964

II. Description of Architectural Details

By Paul S. Martin

A. SECULAR ROOMS—Surface

(Figs. 1 and 2)

Walls

Foundations.—Walls based on reddish, sterile clay with no prepared foundations or wall trenches except in ten rooms (rooms 1, 4, 5, 24, 33, 37–41). In these rooms, bottom course of masonry consisted of vertical sandstone slabs set in trenches 5–20 cm. in depth. *Note:* Some walls with vertical slabs in bottom course set directly on sterile clay or not in trenches.

Construction.—No bonding at corners. Through-stone masonry with stones reaching through from one wall surface to other side; no cores, no composite masonry with two faces interlocked in center. Practice of building four separate walls, all abutting on one another, for one room: and of adding rooms without bonding, makes it difficult to follow building sequence. Sometimes a wall will span one end and one side of a room (room 23) and gives appearance of bonding at corner (northwest corner of room 23).

Types of Masonry.—Masonry can be divided into two general classes:

(a) *unbanded rubble* (Figs. 3, 4); that which belongs to the core or nuclear rooms and, in general, seems to be the earlier; consists of long and medium-long thick slabs alternating with smaller slabs and spalls, all set in thick cushion of adobe mud mortar; coursing, good to rough, apparent on close inspection. In some rooms this class degenerates to mud-rubble wall with large, unshaped stones, all more or less same size, set in mud mortar with fewer spalls, and coursing not pronounced: or to walls composed of course of small slabs alternating with course of large spalls. Wall rocks vary from 25 cm. by 40 cm. to slabs 30 cm. by 20 cm. by 9 cm.; to spalls, 5 cm. by 10 cm. Courses in latter, not maintained but appear as a jumble of irregular stones or change in thickness; are irregular and inconsistent. Sometimes these variations will appear in same wall.

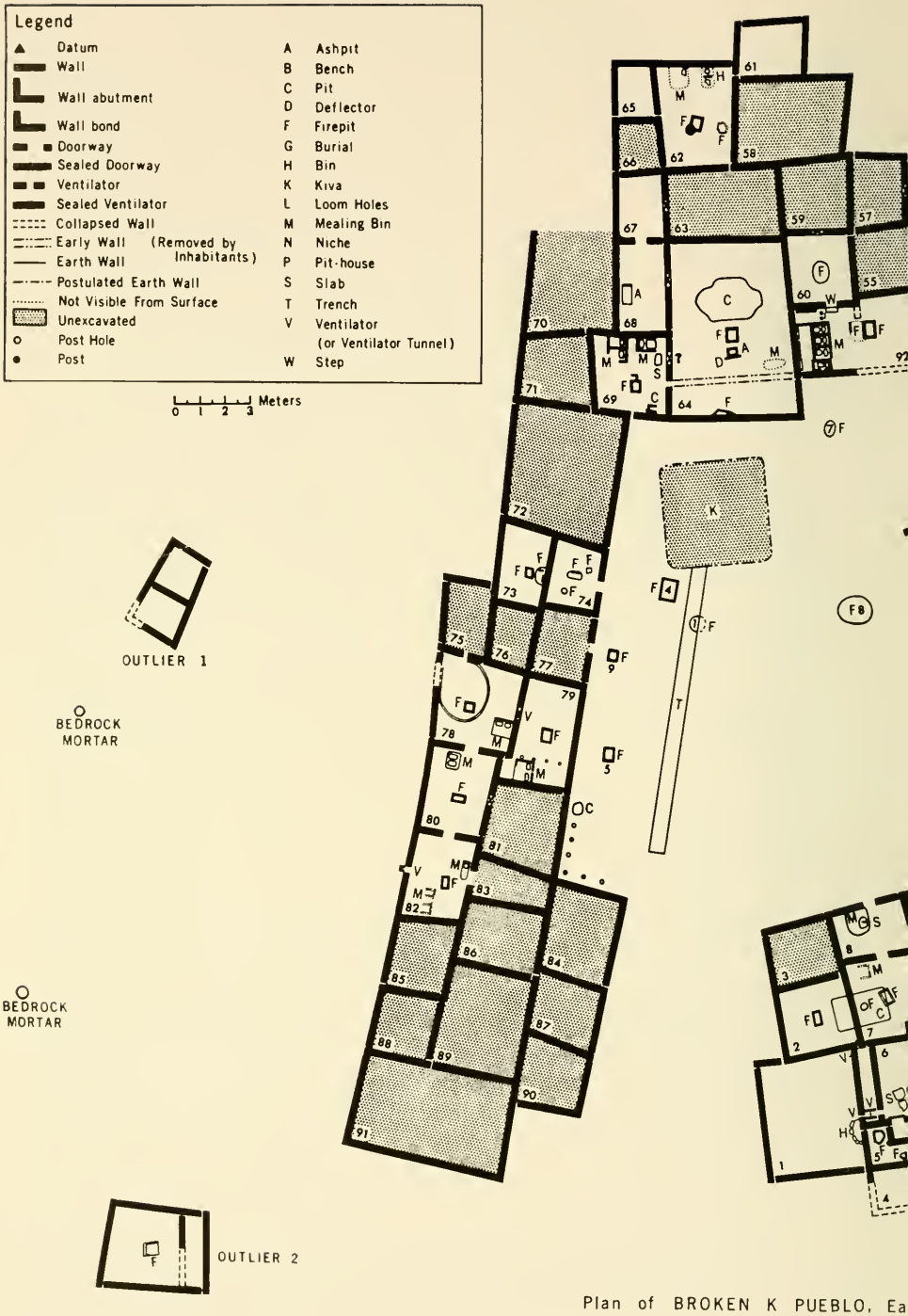

Fig. 1. Map of Broken K Pueblo, East Central Arizona.

OUTLIER 5
OUTLIER 4
OUTLIER 3
decl 13° 27'
N
T
F
M
K
B
C
H
P
V
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48
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l Arizona

(b) *banded*: found in many of later or latest rooms (Fig. 5). At its best resembles a "Chacoan" type of wall—large horizontal slabs (30 by 60 cm.) laid directly on ground; on top of these and laid in even courses, slabs and chips of laminate sandstone; and, alternative with the latter, another course of large slabs (10 by 70 cm.). Stones matched in thickness but not in length or color. *Variations* of this class occur: slabs (30 by 35 cm.) set vertically and often in a prepared trench; on top of these, alternate courses of mud and a few spalls (about 5 cm. thick), and horizontally laid slabs (7 by 35 cm.) (South wall, room 39 [Fig. 6]). More imperfect versions of this under "banded" class were found in north wall of room 64.

Walls not plumb, contain cracks and imperfections. In general, masonry not impressive. It served to keep out rain, cold, heat, winds, and "varmints"; but was not a thing of beauty. Since rooms were only one story high, more massive and better-built walls were not necessary.

Dimensions.—Greatest standing height of walls, 120 cm. (southeast corner, room 54); thickness, average, 17 cm.

Materials Used.—Sandstone and mud.

Surfaces.—Rough hewn, undimpled; tooling absent.

Spalls.—Small stone flakes and small thin, flat, stone slabs used. Potsherds not used. Spalls laid in mortar to level the courses, to fill voids, or to keep wet mortar from squeezing out when next course was laid. All spalls have one edge flush with joints.

Mortar.—A mixture of local clay mixed with sand; hard; served to give strength and permanence to walls and to prevent stone-to-stone contact.

Plaster.—Interiors of walls of most rooms were mud-plastered; several layers of mud plaster were found in some rooms.

Doorways.—Thirty-six doorways located, 22 of which were sealed (Figs. 7–9). All rectangular, located near center of the side or end walls of rooms. No exterior doorways except those that gave on to the plaza. Sills, of sandstone slabs, ranged from 4–40 cm. above floor level; average, 21 cm. Doorway in west wall of room 92 provided with steps 23 cm. to 70 cm.; widths averaged about 50 cm. Lintels of sandstone slabs and sometimes wood beams; sides of doorways of masonry. In south wall, room 49, two sealed doorways side by side, were found, making three sealed doorways in this room. No "T" doorways. In some instances, sealing of doorway may have occurred when addition was added. Other reasons for sealed doorways not known.

It is assumed that rooms without doorways were entered through a ceiling hatchway. The finding of several ring-slabs on floors confirmed this impression.

Fig. 2. Panoramic view of Broken K Site showing rooms and outside walls of north and east wings outlined with trenches.

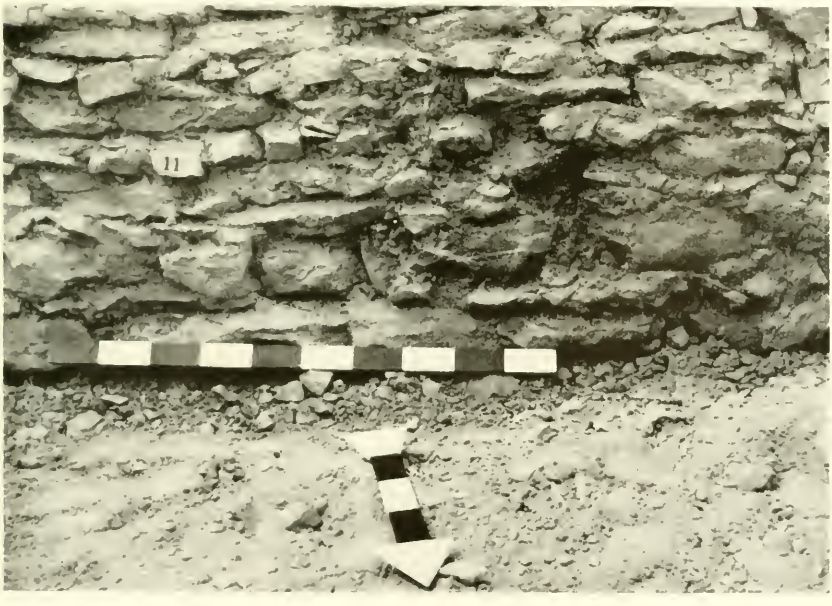

Fig. 3. Masonry, south wall, room 11. Arrow (50 cm. long) points north; meter stick in background.

Fig. 4. Masonry, west wall, room 11. Arrow (50 cm. long) points north.

Fig. 5. Masonry, east wall of room 50.

Fig. 6. Masonry south wall, room 39. Arrow (50 cm. long) points north.

Ventilators in Rooms.—Eleven vents were located: two in room 1; one between rooms 2 and 7; one between rooms 11 and 16; one between rooms 47 and 49; one between rooms 60 and 64; one between rooms 78 and 79; one between rooms 78 and 75; one between rooms 80 and 81; one in south wall of room 82 leading outside pueblo, roof corbelled (?); one in north wall of room 92. One was at floor level (82), others were 15–30 cm. above floor. Dimensions ranged from: heights, 15–40 cms.; widths, 12–20 cms. Some were placed in sealed doorways (after doorways were sealed?). Six of the vents were sealed.

Floors

Materials.—Sandy clay, usually hard; lavender, red, to gray in color; rought to smooth in appearance, but not polished.

Alterations.—Most rooms contained one floor only; eleven rooms out of the 53 pueblo surface rooms were furnished with two floors. Distances between these floors varied from 3–15 cm. Most of the rooms with plural floors were habitation rooms. It is believed that little time elapsed between the building of first floor and the addition of the second. Usually the later, added (adobe) floors covered previous storage pits, pits, metate bins, firepits and miscellaneous holes. Sometimes on the contrary, the later floor (upper) had more features than the lower one.

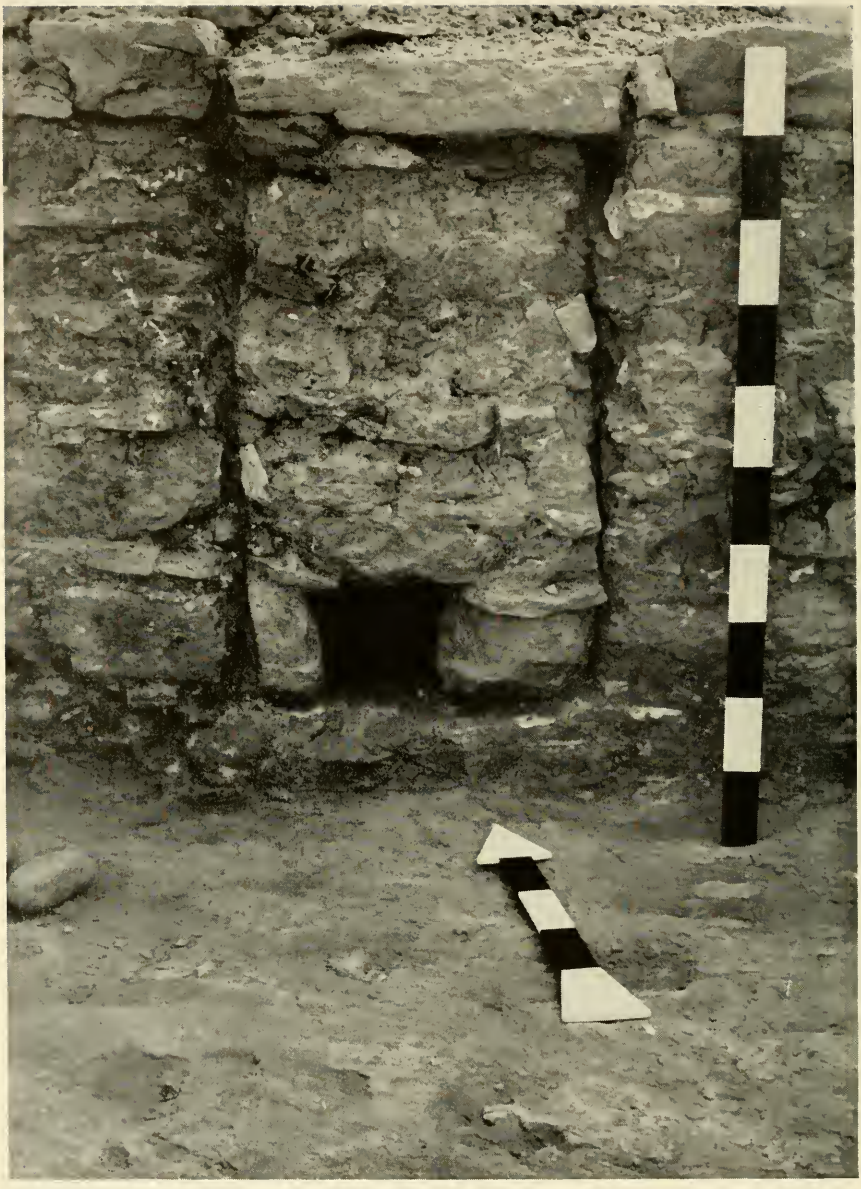

Fig. 7. Sealed doorway center of north wall of room 11. Arrow (50 cm. long) points north; meter stick in background.

Fig. 8. Sealed doorway in center of south wall, room 54. Arrow (50 cm. long) points north; meter stick in background.

Bins (*storage, mealing bins*).—Storage pits and or mealing bins are found in most habitation rooms and sometimes in storage rooms. Mealing bins occurred singly, in pairs; in one room (91) in a set of three, and in room 92, in a set of four (Fig. 10).

Firepits.—Occurred in all habitation rooms (by definition) and sometimes in storage rooms. In latter, were often sealed over by added floor and not used when food was stored therein. It is possible these were habitation rooms converted to storage rooms.

Three types: 1. Round or basin-shaped, earth-lined (Fig. 11); most of these had been sealed over; were often not in center of room; and are found only in storage rooms. Is it possible that these firepits were in existence before the rooms enclosed them or that the firepits had a different function?

2. Hexagonal, slab-lined firepits were found in only a few rooms and usually near a wall, off center (Fig. 12).

3. Slab-lined rectangular firepit (Figs. 13, 14), the most common type. Some with flat bottoms, some with concave, and some with a small sump or pit at the bottom. Range in size from 30 by 50 cm. to 32 by 68 cm. Depths ranged from 18 cm. to 52 cm.

Ceilings

Height.—Actual height unknown. Estimate, arrived at by inspecting rock inside and outside rooms, six feet above floor.

Construction.—Construction or type unknown. From decayed or burned portions of wooden beams and from impressions on burned adobe chinking, believed roofs were similar to those of ancient pueblos: main beams, smaller ones at right angle, splints and/or mats, mud.

Fig. 9. Sealed doorway in west wall, room 68. Arrow (50 cm. long) points north; meter stick in background.

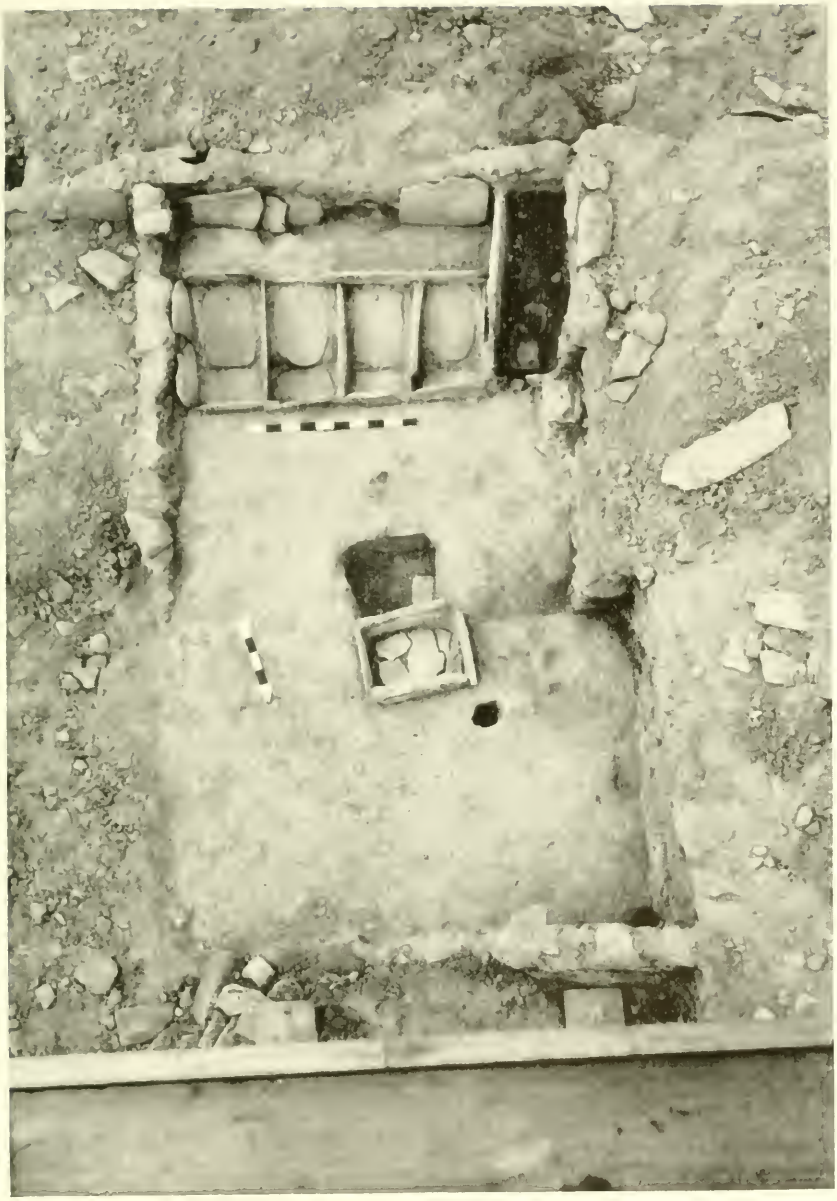

Fig. 10. Mealing bins, room 92. Slab-lined firepit, center; and older firepit, to south of later one. Arrow (50 cm. long) points north; meter stick in background.

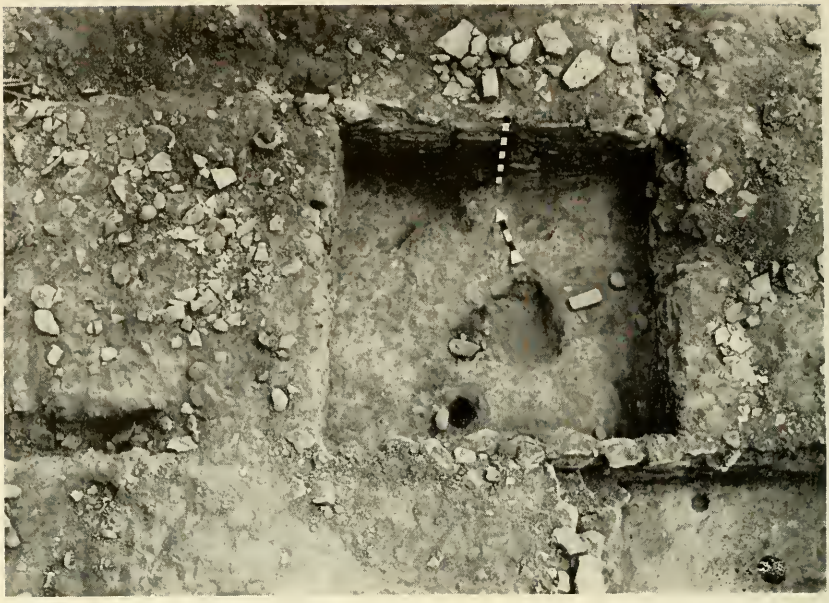

Fig. 11. Firepit, round, room 60. Manos and hammerstones found on floor. Sealed doorway to left of meter stick. Arrow (50 cm. long) points north; meter stick in background.

GENERAL (Figs. 15–19)

Dimensions of Rooms.—Size of habitation rooms varied from 2.4 by 2.8 m. to 4.7 by 5.3 m., and are generally larger than 7.0 sq. meters in floor area. Size of storage rooms ranged from 1.3 by 2.0 m. to 2.20 by 3.50 m., and are generally smaller than 7.0 sq. meters in floor area.

Number of Stories.—One.

Deposits.—Thirty-one rooms contained no trash; fill composed of soil, sand, wall debris, water-laid soil, a few sherds. Twelve of these are habitation rooms and 19 storage (not including outliers).

Twenty-one rooms contained trash, of which 17 were habitation units and four storage rooms. (This count includes surface habitation rooms later converted to kivas and rooms that may have functioned as habitation and/or storage spaces).

The trash in some rooms was relatively thin, amounting to a few centimeters, and deposited on roof beams (room 11). A few rooms contained more ash, sherds, and bones—but the maximum was about 42 cm. in thickness (room 4). This does not take into account trash in subterranean kivas or trash from Forestdale phase pit houses (Haury, 1940) sometimes encountered under floors of rooms (room 28).

Fig. 12. Hexagonal firepit in corner of room 5. Miscellaneous masonry walls represent ventilator tunnel and shaft for surface kiva (4, 5, 6) and supports for bench that had been topped by large stone slabs. Arrow (50 cm. long) points north; meter stick in background.

When I compare the amount of trash that I have encountered in rooms of other pueblos (room 8, Lowry Pueblo—Martin, 1936; and rooms 1A, 2A, etc., Hooper Ranch Pueblo—Martin, Rinaldo, Longacre, 1961a) with that found in rooms at Broken K, I am surprised at the paucity of it at this site. Several suggestions may be put forth to explain the relative scarcity of refuse in rooms at Broken K: 1.) Much was put in the abandoned kivas (under rooms 22, 39, 41, northwest plaza kiva, and unfinished subterranean building in the southwest plaza; 2.) trash was placed on a midden or middens; if this be so, we never found them. Sheet-trash was encountered on all sides of the pueblo and some in the plaza, but it was thin (5–20 cm. in thickness). Perhaps if this volume were stacked, it might make a respectable amount in cubic meters. 3.) trash was dumped in the nearby wash; 4.) perhaps rate of accumulation of trash was slower at Broken K Pueblo for some reason we do not understand. 5.) occupation of the pueblo was of short duration and vast amounts did not develop.

Burned rooms.—Six habitation rooms burned (rooms 21, 37, 53 [Fig. 20] lower floor of 62, 78, and 80) and three more may have (rooms 20, 69, 73). Room 19, a storage room may have burned. Several kivas show evidence of destruction by fire—room 6, after being converted to kiva; kiva under room 41, and northwest plaza kiva. The ceremonial room under room 22 may have burned.

It is amazing to me that relatively few rooms burned. My impression is that many pueblos contain more evidence of conflagrations. Carter Ranch Pueblo (Martin *et al.*, 1964) yielded three burned rooms out of 23 dug. These rooms had really blazed and charred roof beams were found on the floor. The fires in the rooms at Broken K Pueblo seem "cool" by comparison. We found ash-covered, blackened floors and an occasional piece of burned roof clay, but no masses of charred roof beams.

If habitation or storage rooms contained stored corn, one might have hoped for a good, hot blaze—hot enough to bake the plaster on the walls and to crack the wall stones. Is it possible little corn was on hand at the end of the life of the pueblo; or, were the occupants very careful not to let fires start? Insurance rates must have been low!

Functions of rooms.—Rooms at Broken K have been classed as follows: 1. habitation (postulated on the basis of firepits, metates, grinding bins, tools, occupation debris); 2. storage units (Fig. 22) (so classed because they usually lack firepits, and because they are relatively smaller than habitation rooms and contain few if any artifacts); 2a. rooms that might first have been habitation rooms and then converted to storage or vice versa—rooms 40, 48, 51, and 74. It should be noted that firepits in rooms 40, 48, and 51 were sealed by secondary or later floor; from which I

Fig. 13. Slab-lined firepit, room 2. Arrow (50 cm. long) points north; meter stick in background.

Fig. 14. Slab-lined rectangular firepit, room 7. Sealed rectangular box to left, represents mealing bin. Arrow (50 cm. long) points north; meter stick in background.

Fig. 15. Room 27. Firepit in center; mealing bin east of firepit. Arrow (50 cm. long) points north; meter stick in background.

deduce that function of rooms changed. This supposition is strengthened by fact that after firepit in room 48 was partially dismantled, the area was then covered by large slab and used as grinding bin or storage pit; 3. ceremonial (later stages of rooms 6, 29, and rooms under 22, 39, 41, and in northwest corner of plaza.)

It should be added that evidence exists for supposing that roof tops were extensively utilized for common tasks, e.g., grinding, weaving, painting pots, whittling, maintenance, and repair of tools, and gossip.

Nuclear or "core" units.—The order in which rooms were constructed was exceedingly difficult to determine with much certainty. The chief reason for this is that even the walls of primary rooms were rarely built with four bonded corners. We thought ourselves lucky if we found two adjoining walls bonded at point of contact. Abutments were the rule.

Nevertheless, prolonged study has brought forth certain conclusions of which we feel fairly certain.

The primary rooms were (Fig. 23):

East wing: rooms 11, 12, 13
West wing: rooms 54, 55, 57

North wing: rooms 31–34
South wing: rooms 73, 74, 76, 77; and 80 and 82.

It will be noted that I have grouped the east and west wings. My colleague Hill feels that these were the first units to have been established at Broken K Pueblo.

Shortly thereafter, (perhaps a year or a few years later) the units in the north and south wing were built (Fig. 24).

At the moment, we feel that the earliest occupants had a quadrilateral plan in mind and that the pueblo, in that sense, was pre-planned. As the nuclear families increased by means of matrilocal marriages, rooms were added as needed.

It is barely possible that all the rooms (almost 100) were occupied simultaneously. The evidence on this point is not too clear; the available data suggest, however, all sections were inhabited at peak or near end of, occupation. We visualize the pueblo as a living organism made up of cells (rooms) some of which were being created while others were sloughed off.

Fig. 16. Room 24. Thick slab-lined firepit in center with pot-rest; mealing bin in northwest corner with mano *in situ*. Mealing bin in southwest corner with metate set exactly vertical, held up by plaster around base. Mano in place. Arrow (50 cm. long) points north; meter stick in background.

Fig. 17. Room 62. Firepit in center. Hexagonal slab-lined firepit north of arrow; fire-cracked stones next to it were found in pit. Arrow (50 cm. long) points north; meter stick in background.

Fig. 18. Room 79. Slab-lined firepit in center. Alcove in southeast corner with double grinding-bin north of it. Arrow (50 cm. long) points north; meter stick in background.

Fig. 19. Room 80. Slab-lined firepit in center; round pit in bottom. Doorways in west and east walls. Slab leaning against wall next to east door may have been used to close door. Arrow (50 cm. long) points north; meter stick in background.

Fig. 20. Room 53. This room had burned. Four metates were found on floor. Two posts were found in the walls. Shallow slab-bottomed pit next to the north wall is probably flour receptacle for a mealing bin. Unplugged doorway in the north half of the west wall. Arrow (50 cm. long) points north; meter stick in background.

Alterations.—A few alterations will be mentioned. Rooms 5, 6, and 29 were converted from habitation rooms to kivas. Details concerning these changes will be discussed under section on *Kivas*.

Rooms 31 and 33 were two separate units but were later thrown into one. The firepit belonging to room 33 was sealed over at that time and the extant one was built. The same order of events occurred in rooms 35 and 37.

The west wall of room 49 was placed over an earlier *pi-gummi* (Fig. 25).

Room 92 was at one time two rooms.

Room 64 (Fig. 26) was enlarged and the new east wall was built over an earlier firepit.

Rooms 22, 39, and 41 were erected over earlier kivas, which were abandoned and filled with trash (Fig. 27).

The south wall of room 27 was built over a burial pit.

Pit houses belonging to the Forestdale phase (A.D. 600–800) were found to have existed under rooms 33 and 48.

The kiva under room 41 lay on top of an earlier pit house floor.

Fig. 21. Room 69; burned. Firepit, with pot rests, in left center; ash pit adjoining firepit to west. Upside down slab metate east of directional arrow. Double mealing bin in southwest corner. Single mealing bin near northwest corner. Arrow (50 cm. long) points north; meter stick in background.

Fig. 22. Room 61. Various "storage pits" and possible post holes. Arrow (50 cm. long) points north; meter stick in background.

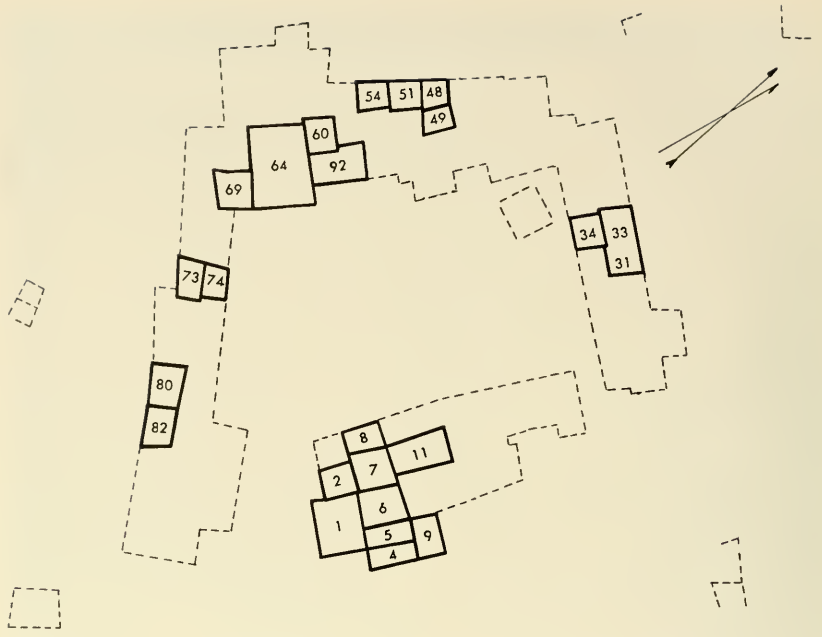

Fig. 23. Earlier rooms (about A.D. 1150) some of which were occupied throughout the life of the pueblo.

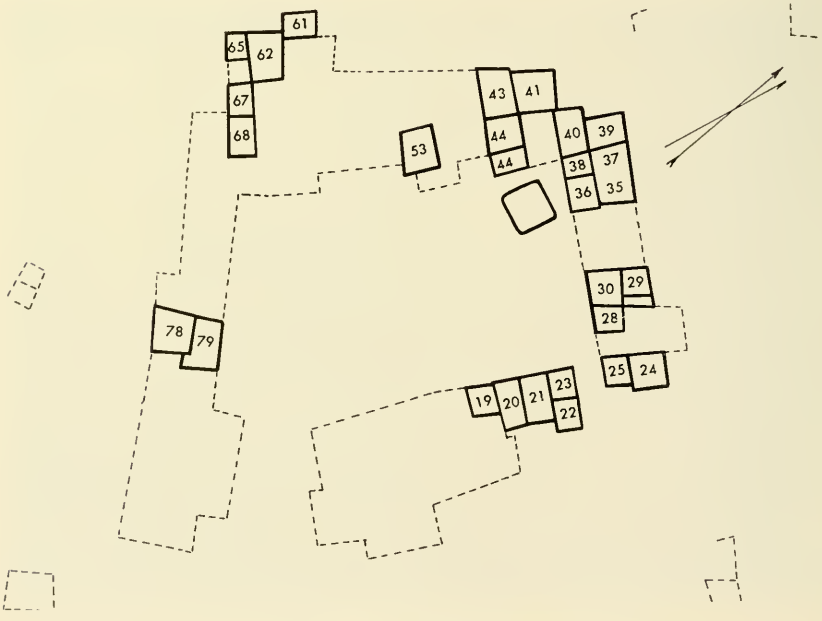

Fig. 24. Later rooms, most of which were occupied until abandonment.

Fig. 25. Room 49. Shallow, round basin-shaped firepit in southwest quadrant. Large slab-lined structure extending under west wall into room 48, a roasting pit. It was sealed and antedates both rooms; contained ash, charcoal, and 30 sandstone and basalt burned rocks. In south wall behind and to the west of meter stick is a plugged doorway. Arrow (50 cm. long) points north; meter stick in background.

Under rooms 2 and 7 and the east wall of room 9, we found earlier, pre-existing firepits.

Room 78 contained remnants of an oval-shaped wattle and daub structure (oven?) (Fig. 28). The upright sticks had burned.

Plaza.—Contained unfinished (?) room (kiva?), a bin or repository (center), and nine firepits. Several of the latter may have been roasting pits (Figs. 29–31).

Outlying or detached rooms.—There were five of these; purpose unknown (Figs. 32–33).

B. KIVAS

General.—Six kivas were discovered—four subterranean and two surface. Four kivas of the six were excavated. In the southwest corner of the plaza, another depression was located. Excavation revealed a chamber cut into bedrock. Although this depression resembles an unfinished kiva, its function is not known.

Two of the excavated kivas were subterranean; two were converted surface rooms and were thus part of the surface pueblo.

Surface Kivas (Rooms 4, 5, 6)

The kiva, occupying spaces numbered 4, 5, and 6 on map, was not built as a ceremonial room.

Briefly, the history of this area is: rooms 4 and 5, previous to conversion, made up one habitation room. The slab-lined, rectangular firepit was centered in the larger space, rooms 4 and 5, and later, was abandoned and the east wall of room 5 was built over it. The hexagonal, slab-sided firepit (Fig. 12) in the southwest corner of room 5 may have been an exterior firepit used before the building of rooms 5 and 6. Room 6 had likewise been a habitation room provided with standard rectangular firepit, mealing bin, and storage pit.

When the people decided to convert the area (rooms 5 and 6) to a kiva, the firepit and other pits in the floor (of room 6) were sealed over by a second floor (about 5 cm. above the first one). What happened to the occupants of former rooms 4, 5, and 6 is not known. They may have died, they may have left voluntarily, or they may have been evicted.

The kiva (Fig. 34) was then constructed. In room 6, a secondary wall on the south was erected and a *ventilator* opening southward was con-

Fig. 26. Room 64. Firepit in center with ash pit east of it. Sealed ash pit immediately north of arrow. Note: Foundation of previous north–south wall immediately west of meter stick and paralleling it. Arrow (50 cm. long) points north; meter stick in background.

Fig. 27. Rooms 41 and 43; room 41 (lower part of picture): slab-lined firepit in center; pit in southeast corner. It contained Snowflake Black-on-white, Snowflake variety vessel. Kiva fill extends under north wall; shovel standing on fill material above floor of kiva-41. Room 43 (upper) slab-lined firepit in center; mealing bin on west wall. Arrow (50 cm. long) points north; meter stick in background.

Fig. 28. Room 78. Mealing bin in northeast corner. Slab-lined firepit in center. Slab near east wall probably used to close doorway in east wall. Circular structure in the southwest part of room discovered below floor level. It is the base of a wattle and daub structure. Purpose unknown; It may represent earlier structure. Arrow (50 cm. long) points north; meter stick in background.

structed (similar to one in 41 kiva?). Later this was sealed. A firepit (50 cm. deep, 29 cm. diameter) with round orifice (of stone) was constructed east of the earlier lower firepit. Several slabs were placed west of the firepit; and four loom holes were constructed north of firepit—three in slabs and one in floor. A *ventilator* (40 cm. wide by 10 cm. high by 70 cm. long) was built at floor level in the east wall of what had been room 6, with the flue shaft projecting upward in room 5. The opening of the tunnel (on the kiva site) was provided with a slab facing pierced by a rectangular opening. Immediately back of face-opening of this slab a rounded (pecked) rock was found. This may have served as a damper if needed.

Between the firepit and slab facing was the deflector (29 cm. long, 1.3 cm. thick, 7 cm. high [probably broken]) set east of firepit by 12 cm.

An "ash pit" was situated between the deflector and the ventilator opening.

In the center of "room 5" and running north and south, a wall, composed of inferior masonry interspersed with and strengthened (?) by

Fig. 29. Plaza; firepit 7. No slab-lining; charcoal and fire-cracked rock on floor of pit. Arrow (50 cm. long) points north, meter stick at right.

Fig. 30. Plaza; firepit 4. Two levels: lower level, circular. On floor, charcoal and fire-cracked igneous rocks.

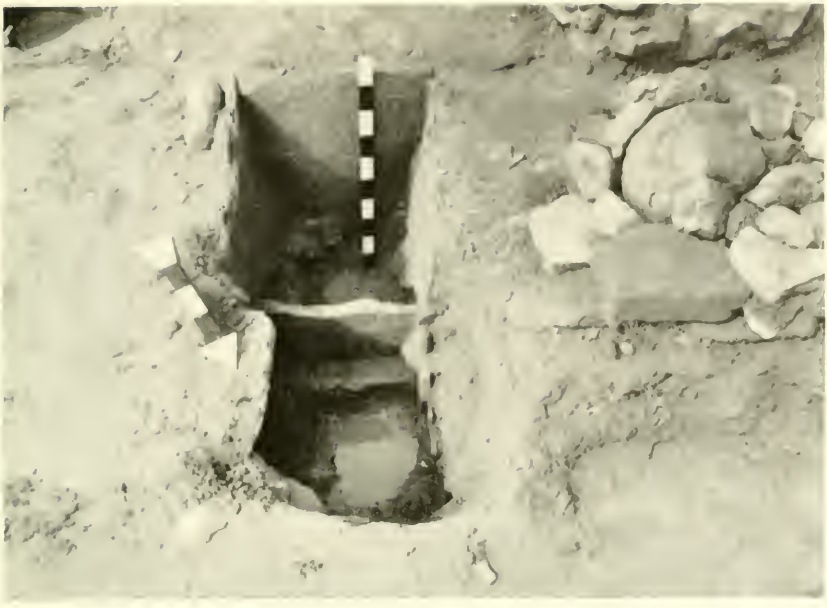

Fig. 31. Plaza; firepits 1 and 2. Meter stick in pit 1. Top portion of vertical slab siding is missing on north and west walls. East wall slumped. Vertical dividing slab rests on horizontal worked slab which extends into both firepits. Fire-cracked igneous rock at right of pits. Arrow (50 cm. long) points north; meter stick in background.

seven posts was built to a probable height of 70 cm. The space thus enclosed (between the east wall of room 6 and the new wall of poles and rocks) was covered or roofed over by large slabs, each 1.20 m. long and about 70 cm. wide. Since the ventilator was roofed with poles and slabs and the enclosure by the two large slabs, two hollow spaces were thereby created. The south one probably served as a *cupboard* and was closed on the kiva side (east wall of kiva) by a slab. The north space was apparently not used and was closed by masonry. In this masonry wall, a small *vent* was placed—purpose unknown.

The roofed over area described above thus provided a *bench* or "altar" with slab flooring—about 90 cm. high, about 1.40 cm. deep and running the north-south width of the room, or 2.75 m.

"Room 4" was filled with trash as were parts of "room 5" around ventilator construction and east and south of the rear facings of the bench.

The space created by the "new" wall on the south side of room 6 and of the west half of the north wall of room 1 was likewise trash-filled.

The walls of room 6 were similar to those in rooms 7 and 11. The dimensions of the kiva were 2.7 m. by 2.8 m. The roof of the kiva may

have been about 2 m. high and was probably constructed of logs, poles, branches, and mud. Entrance to the kiva must have been via a roof hatch.

After some months (?) or years (?) of usage, this kiva burned and some trash was later deposited therein.

Surface Kiva (Room 29) (Fig. 35)

The secular history of room 29 before conversion to a "kiva" is not known. To convert the room to a kiva, a bench, a ventilator opening in the north wall and a paving of large, thin sandstone slabs were added. After the bench or "altar" was installed, the floor area was reduced to 5.75 sq. m. (about 2.5 m. east and west; and 2.3 m. north and south). The surface of the bench was made up of sandstone slabs; and the vertical face was composed of stone slabs placed upright with horizontal masonry on top of them. This kind of construction seems to occur only in late additions and alterations.

Ventilation was obtained by means of an opening in the east face of the bench and another opening to the outside in the north wall of the partitioned area. We assume that the area inside the bench was hollow and that the fresh air flowed into this area from the north opening and thence into the kiva via the opening in the face of the bench. It is possible that a masonry or wattle-and-daub shaft connected the opening of the north wall directly with the vent opening in the east face of the bench. Excavation of the enclosed bench area failed to provide us with specific information on this point.

Subterranean Kiva Under Room 41 (Figs. 36, 37)

Shape.—Rectangular.

Fill.—Ash, sherds, discarded stone tools.

Size.—2 m. wide (north-south) by 3 m. long (east-west) including bench. Available floor space (omitting bench) was 2.30 m. (E.–W.) by 2 m.

Depth of floor below floor room 41 and surface.—2 m.

Walls.—Of native red clay over which lay several coats (3 mm. thick) of sooty plaster of clay.

Floor.—Of native clay overlain by blackened clay plaster, and sloping slightly towards firepit. The east portion of this floor was 3 cm. over floor of earlier Forestdale phase pit house (A.D. 600–800).

Firepit.—"D" shaped, with vertical slab on flat, or east side; 35 cm. east-west; 43 cm. north-south; 51 cm. deep. Lining of firepit of native clay baked hard, red in color. Contained ash, charcoal, basalt, and sandstone rocks, sherds.

Fig. 32. Outlying room 2. Floor is bedrock. Rectangular firepit, slab-lined on two sides with pot rest. Two overlapping bowl-shaped pits dug into bedrock to west of firepit and later sealed. Arrow (50 cm. long) points north; meter stick in background.

Fig. 33. Outlier 1; floor is bedrock. Arrow (50 cm. long) points north; meter stick in background.

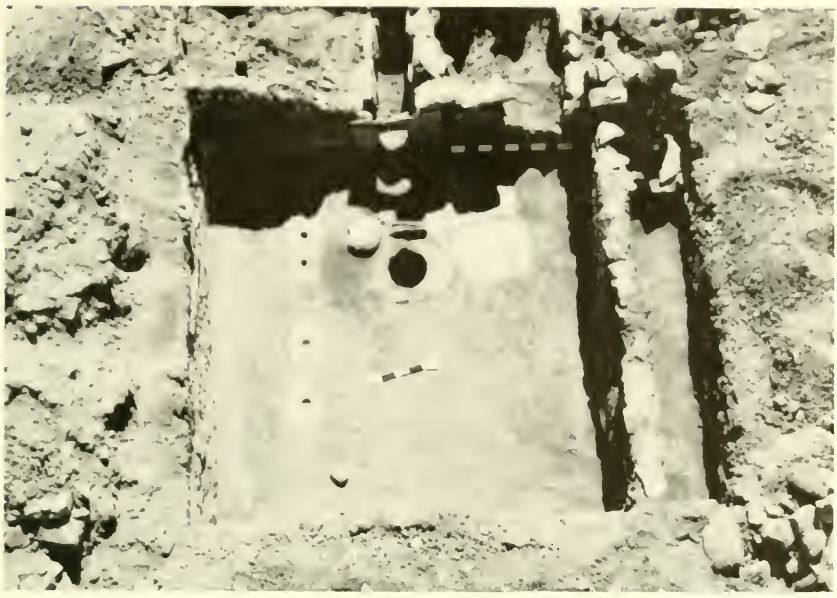

Fig. 34. Surface kiva (room 6). Four loom-holes in floor on east side. Firepit, clay-lined and provided with ring-slab for orifice. East of firepit are deflector and ash-box. A slab-faced ventilator-tunnel extended into former room 5; another slab-faced ventilator-tunnel extended south with shaft opening in room 1. East ventilator system was functional; south system, sealed. Metate, north of firepit. Arrow (50 cm. long) points north, meter stick in background.

Deflector.—A sandstone slab, upright; 4 cm. thick; 40 cm. long; and 25 cm. high. Deflector placed 25 cm. east of firepit and 90 cm. west of ventilator opening in bench.

Bench.—Carved or "sculptured" from aeolian fill in earlier and abandoned pit house. Bench is 40 cm. high and 65 cm. deep (east-west). In center of top of bench surface next to east wall, is a large pit, 40 cm. by 32 cm. and connects with ventilator tunnel. Where horizontal and vertical faces of bench meet, a wooden beam (6 cm. thick) was placed as edging to prevent friable bench material from crumbling. Beam ran entire width of bench and north end *socketed* in slot in wall.

Ventilator.—In center of bench face, almost at floor level; 20 cm. wide and 20 cm. high. Opening to ventilator tunnel is horseshoe-shaped stone slab. The tunnel is 1 m. long to point where it connects with the vertical shaft. Walls and roof of tunnel of sandstone slabs.

Niches.—Two in number; *one*, centered north and south in west wall, floor of which is 30 cm. above floor; dimensions: width, 70 cm.; height, 25 cm.; and depth, 25 cm. In it was fragment of a one-hand mano. The

second in the south wall in the southwest corner, the floor of which was 30 cm. above floor; width, 55 cm.; height, 30 cm.; depth, 33 cm. This second niche had been sealed with sandstone slabs set in copious amounts of adobe mortar, all of which had been neatly covered with mud plaster 3 mm. thick. This plaster coating had become blackened with soot after which another coat of plaster (2 mm. thick) was applied to area around sealed niche and this, in turn, became smoke blackened.

Pits.—Three in number; *one*, (pit G), in northeast corner of bench; sealed with mud plaster. Contents: ash, charcoal, four flint chips and two cores. Dimensions: diameter 18 cm. by 23 cm.; depth, 14 cm.

The *second* (pit H) in the southeast corner of bench; sealed with three horizontally placed sandstone slabs and under them, a plaster plug. Contents: ash, reddish-brown sand, four flint chips, and a flint saw.

The *third* pit (pit A) in center of top of bench next to east wall and extending for 20 cm. under the east wall; sealed with adobe mortar. Contents: seven pebbles of banded fine-grained stone; four of which had been used as hammerstones and three of which had been broken or had had flakes struck off one surface.

Entrance.—None found; assumed entry was gained by means of hatchway in roof and ladder.

Postholes.—One found, close to south end of deflector on east side; diameter, 8 cm.; depth, 3 cm. Use, unknown.

Roof.—On and near floor, hundreds of pieces of baked roof clay bearing impressions of beams and twigs. No beams found; but in absence of vertical roof supports, it is assumed that main roof beams rested on the surface of the ground and probably extended north and south, the short dimension of the kiva. Then other beams, running east and west, were placed on main timbers. Ceiling was probably about 2 m. above floor.

Secondary Ventilator (?).—Immediately (81 cm.) west of bench, in south wall, and 34 cm. above floor was an aperture sealed with sandstone slabs set horizontally and diagonally. Dimensions of opening when unsealed: height, 30 cm.; width, 23 cm. The opening was explored and after removing soft dirt fill, was found to extend south for 1 m. ending in a vertical opening 32 cm. in diameter. This in turn extended upward for 70 cm. At time of excavation, it was called a secondary (?) ventilator, although its position above the floor level (34 cm.) makes this unlikely. The entire aperture is too small for use as a secret (?) or sacred (?) entryway to the kiva, unless used by a small person or child. The construction of this feature is a puzzle, especially the vertical shaft that probably had (at one time) extended to the ground level.

Fig. 35. Surface kiva (room 29) with floor of flagstones and rectangular, slab-lined firepit. Bench on east side (partially destroyed by vandals) was pierced by ventilator opening; tunnel, however, ran north. Arrow (50 cm. long) points north; meter stick in background.

Fig. 36. Kiva under (later) room 41. Round firepit near center; east face, slab-lined; pot rests(?) in firepit. East of firepit is deflector. Earthen bench provided with edge-joint consisting of a log; is pierced by ventilator tunnel, face of which is horse-shoe-shaped ring slab. Pit in top of east bench contained four hammerstones. Arrow (50 cm. long) points north, meter stick on bench.

General Remarks.—Since the walls and floor of room 41 were built over the kiva, it is obvious that the kiva was built and used before the existence of room 41.

The floor of the kiva was laid on top of a floor of a pit house that belonged to the Forestdale Phase (A.D. 600–800).

The rectangular shape of this kiva is similar to others of this time period in the area of the Upper Little Colorado Drainage and, of course, to kivas of the same period in the Hopi country. Many artifacts were found on the floor and a few on the bench. From the floor: bone rings and raw materials for making rings; a projectile point; 3 scrapers; 7 hammerstones; 3 choppers; 2 one-hand manos; fragments of 7 other manos; 5 stream pebbles, some of which were large enough to serve as seats; 3 bone awls; one marked slab of wood (altar piece?); splints of yucca; a "brush" of twigs; a corn stalk with corn cob attached; corn cobs (25); squash seeds; pieces of twilled matting; 2 ribs of a very large mammal; one corrugated jar (small); 2 stone "tinklers"; on the bench: 1 deer antler and 2 deer legs; 5 hammerstones.

Fig. 37. Kiva under room 41; detail of east end; pit in bench; log embedded in edge of bench; horseshoe-shaped ring slab ventilator opening; deflector and east edge of firepit. Arrow (50 cm. long) points north; meter stick in near background.

Northwest Plaza Kiva

Location.—In northwest corner of plaza.

Fill.—Entire kiva filled with rich, artifact- and sherd-bearing trash except for top 35 cm. Depth of fill was 1.75 m.; of which 1.40 m. was "artifactiferous."

Shape.—Square.

Orientation.—East and west walls, magnetic north.

Size.—3.45 m. at floor level; only 2.90 m. at ends. Walls curve slightly.

Depth of floor below surface.—1.75 m.

Walls.—Of native earth; plastered with two layers. At top of walls, possibly two to three courses of masonry.

Floor.—Of native clay, with two layers of plaster, each 15 cm. thick.

Bench.—Composed of sterile red clay; may have been sculptured of undisturbed and untouched earth. Width is 3.4 m.; depth (east-west), 85 cm.; height above floor, 50 cm.

Pilasters.—None.

Firepit.—Bowl-shaped with flat bottom. Diameter, 32 cm.; depth 21 cm. Distance of firepit from north wall, 1.23 cm.; from west wall, 1.5 m.; from bench, 80 cm.; lined with small thin sandstone slabs to a depth of 12 cm.; under them, native clay, burned red. Bottom of pit sunk into bed rock for 3 cm. Contents: ash; some charcoal.

Ashpit.—Directly east of firepit; square in shape; sides and bottom, of sandstone slabs; slabs on sides flush with floor; length and width of pit, 24 cm.; depth, 10 cm.; slab on west edge of ashpit (small deflector?) is 2 cm. thick and 10 cm. high. Contents: ash.

Deflector.—Makes up north side of ashpit; dimensions: 4 cm. thick; 20 cm. high. Between deflector is a slight depression, sides of which are bounded by slabs set flush with floor. Dimensions of this depression are: width (east-west) 40 cm.; length, (north-south) 46 cm. inside measurements. Floor of depression of native earth.

Ventilator.—Opening unadorned with any special horseshoe-shaped slab; runs almost due east for 85 cm., the depth of the bench, and there joined a vertical shaft. Dimensions at face of bench, 30 by 30 cm. Floor of tunnel slopes upward at an angle of 10 degrees. Roof of tunnel composed of small cross-beams and slabs.

Cupboard (?).—Just south of ventilator tunnel was a storage area similar in general position to one found in kiva 4-5-6. The north edge of the opening was 10 cm. south of vent-tunnel. The floor sloped slightly upward towards the east. The rear wall of this cupboard extended 10 cm.

farther east than the east wall of the kiva; total length was 1.12 m. In section, the pit widened from 30 cm. at the front to 59 cm. at rear, and was shaped somewhat like a truncated teardrop. The compartment was 75 cm. high, and was roofed by slabs set in the bench. Access to the cupboard was sealed with stone slab 36 cm. wide and 37 cm. high, and that was set in floor of kiva to a depth of 7 cm. Floor of cupboard was of stone slabs. Under them were three "pottery rests" of coiled juniper bark.

Niches.—One, in north wall near bench at height of 90 cm. from floor. Dimensions: width, 70 cm. east-west; height, 25 cm.; depth, 40 cm. Contents: nothing.

Pits in floor.—None.

Postholes.—One, in north wall, 50 cm. from north wall, and 80 cm. above floor; depth, 20 cm. May have been horizontal post or beam to support a shelf.

Roof.—Burned clay impressions on floor indicate roof composed of beams, cross-beams, branches, and mud, same as roofs of surface rooms. Beams might have been set criss-cross at right angles to one another with beam-ends resting on masonry; or beams could have been placed across corners to form a cribbed roofing or dome. Height of ceiling on inside of kiva about 2 m.

Entrance.—By means of a roof-hatchway.

General Remarks.—Kiva had burned and then was filled with trash. Egg shells were found in fill near the floor. Firepit contained fragments of corn cobs.

III. Artifacts

By William A. Longacre

A total of 2931 artifacts of stone, bone, shell, baked clay, and cordage was recovered from Broken K Pueblo. The purpose of this chapter is twofold: (1) to present the basis for the descriptive classes and types of these artifacts, and (2) to provide interpretive statements regarding these artifacts and their distribution in the Pueblo. Descriptive details and provenience of individual artifacts are recorded in the Archives of Archaeology series (Martin, Longacre and Hill, 1966). Inferences from the distributions of certain tools at the site are reported elsewhere (Longacre, 1966) and will not be repeated here.

The artifacts here described were cataloged in the field by Miss Anna Rose working under the direction of Martin, Hill, and Fritz. Because certain descriptive data were not recorded in the original cataloging and because I wanted to check the basis of the typology, I undertook the task of completely reworking the collection of cultural items recovered from Broken K. This was only made possible by the careful work done in the field by Miss Rose and the others in their exact recording and labeling of individual specimens.

I was helped in this project by a number of people. Without their aid this work and the resulting report could not have been completed. I must, however, assume full responsibility for the shortcomings.

I acknowledge the aid of the following individuals and thank them for their generous assistance. Miss Margaret Hardin, a graduate student in the Department of Anthropology, University of Chicago, aided me in the initial sorting and analysis. Miss Susan Wartell, a graduate student in the Department of Anthropology, University of Illinois, spent an entire summer working as a volunteer on this project. For her hard work and insight-filled suggestions, I am most grateful. Mr. Allan Hammaker, a student at Antioch College, helped in the sorting of artifacts and made many of the metric observations. The tedious calculations involved in the statistical tests for significance applied to the metrical attributes of the tools made on flakes (pp. 94–99, below) were undertaken by Mr. Elliott Simon, a graduate student, Department of Human Development, University of Chicago. The identification of the shells made into artifacts was carried

Fig. 38. One-hand mano, single grinding surface from room 11, floor. Length is 13.5 cm. Shown here are both top and bottom faces. (upper).

Fig. 39. One-hand mano, two grinding surfaces from room 31, floor. Length is 17 cm.

out by Dr. Alan Solem, Curator of Lower Invertebrates, Field Museum of Natural History. Faunal identification of artifacts of bone was made by Dr. Joseph Curtis Moore, Curator of Mammals, Field Museum of Natural History and Dr. Donald F. Hoffmeister, Museum of Natural History, University of Illinois.

For the descriptive portion of this report, I have tried to follow Rinaldo's classification of artifacts from the Carter Ranch Site (Martin *et al.*, 1964b, Chap. III) as much as possible. This was attempted to aid the comparative value of this report. I was generally successful in this endeavor, but there are significant differences in the typologies which are noted in the following pages.

GROUND AND PECKED STONE

Manos.—The 490 manos recovered from Broken K Pueblo were classified on the basis of size, form, and the nature and number of grinding surfaces. There were 230 whole manos excavated and 260 fragments.

All were partially shaped by pecking and grinding and the edges of many were roughed into shape by flaking (Fig. 38). Grinding surfaces ranged from flat to convex with the latter being more frequent. Manos with a single grinding surface were slightly more frequent (191) than

those having two grinding surfaces on opposite faces of the mano (172). This is similar to the data from the Carter Ranch Site (Martin *et al.*, 1964b, p. 63).

Typologically, the manos from Broken K Pueblo were segregated into two major classes based upon size and shape. Those having a roughly square or circular outline were classified as cobble or "one-hand manos"; those with a rectangular shape were classified as "two-hand manos." These major classes were further subdivided into types on the basis of the number and nature of the grinding surfaces. The types and frequencies of manos are as follows:

One-hand manos, single grinding surface (Fig. 38): 46 (34 whole examples; 12 fragments).

One-hand manos, two grinding surfaces (Fig. 39): 41 (36 whole; 5 fragments).

Two-hand manos, single grinding surface (Fig. 40): 145 (77 whole; 68 fragments).

Two-hand manos, two grinding surfaces (Fig. 41, Fig. 42): 131 (53 whole; 78 fragments).

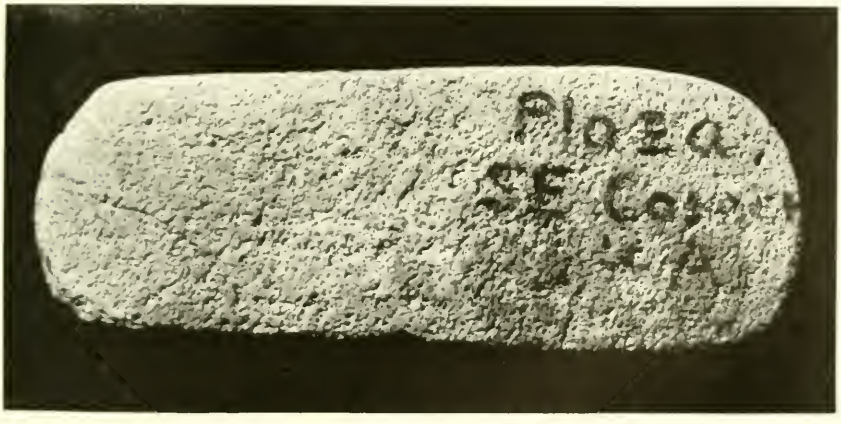

Fig. 40. Two-hand mano, single grinding surface from Broken K Pueblo. One edge has finger groove. Length is 34.4 cm.

Two-hand manos, beveled type—grinding surface beveled into two planes on one surface (Fig. 43, Fig. 42): 116 (27 whole; 89 fragments).

Mano "blanks"—unused rectangular blocks of stone, roughed into two-hand mano size and shape, but showing no evidence of use: 3 whole examples.

Fig. 41. Two-hand mano, two grinding surfaces with finger grooves worked into two edges; from the roof of room 11. Length is 23.3 cm.

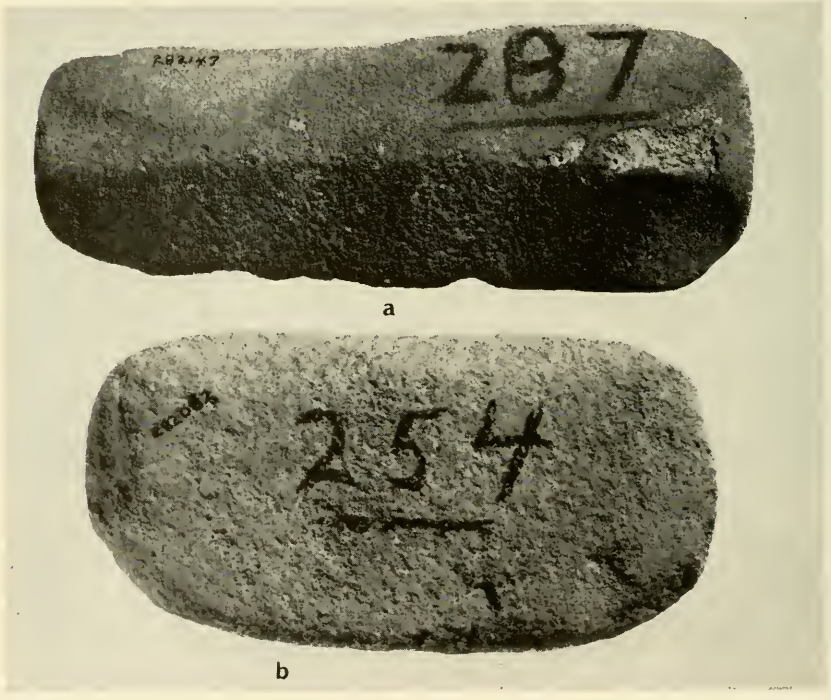

Fig. 42. Manos, Beveled type, *a;* two-hand mano, two grinding surfaces, *b*. Length of *b* is 22.5 cm.

Indeterminate mano fragments—size, shape, and type indeterminate: 8.

General comments: about one-fifth of the manos had depressions pecked in their sides or with their sides slightly incurved which may have served as grips (Fig. 40, Fig. 41). The presence of so many rectangular, beveled type manos would seem consistent with a relatively late date for the occupation of the site, perhaps into the beginning of the 14th century (cf. Martin *et al.*, 1964b, p. 65; Woodbury 1954, p. 70). If the general correlation between lateness of time and increasing frequency of beveled type manos is valid, then it would seem that Broken K Pueblo would be earlier than Table Rock Pueblo which seems to roughly bracket the 14th century. At the latter site, about one-third of the manos were beveled (Martin and Rinaldo, 1960b, p. 225) whereas only about one-fourth of the manos at Broken K were of this type.

Metates.—A total of 65 metates was recovered from the Broken K site. Whole examples numbered 45, while fragments accounted for 20 additional metates.

The metates were of three basic types: basin metates—irregular block of stone with a circular, depressed grinding surface: 7 (5 whole examples; 2 fragments); trough type—roughly rectangular block of stone, grinding

Fig. 43. Two-hand mano, beveled type with three grinding surfaces; (room 33 below mealing bin). Length is 19.9 cm.

surface forms trough through surface: 7 (1 whole; 6 fragments); and slab type—rectangular block of stone, whole of top surface forms nearly flat grinding surface: 50 (39 whole; 11 fragments). There was one fragment recovered that was too small to permit a reliable estimate of type.

It is significant that the majority (77 %) of the metates are the slab type. Rinaldo (Martin *et al.*, 1964b, p. 67) has noted the observed trend of

gradual replacement of other metate types by the flat slab metate (cf. Bartlett, 1933, p. 26). This seems to correlate in a general sense with the use of mealing bins (cf. Martin *et al.*, 1964b, p. 67; Bartlett, 1933, p. 26). None of the metates of the basin or trough types was found in association with a mealing bin, however, 11 slab type metates were found in place in bins.

There were many fewer slab metates at the Carter Ranch Site as well as fewer mealing bins. This would argue for a later date for Broken K Pueblo and as such is consistent with our other data. Rinaldo interprets the high frequency of fragmentary metates and manos at the Carter Ranch Site as indicating intentional breakage before abandonment (Martin *et al.*, 1964b, p. 67). It may also be interpreted as an indication that unbroken tools were carried out of the Pueblo for future use at another location, creating an unusually high number of fragments in relation to the number of whole examples. At Broken K Pueblo, the majority were whole (45 out of 65).

The metate types from Broken K Pueblo are not illustrated. They are basically similar to the types from the Carter Ranch Site (cf. Martin *et al.*, 1964b, Fig. 28).

Mortars.—Twenty-two mortars were recovered from the excavation of Broken K Pueblo. These are stone cobbles or slabs with one or more circular depressions worked into the surface. One of the most important attributes of this class of tools is the nature of the cavity itself. The depressions of the mortars contain no angular facets; the sides and bottoms of the cavity are curved and smooth. The class labeled mortars can be divided into two types based on the metric attributes of the depression.

The first type has a cavity worked in the surface that is relatively small and shallow. The circular depression on mortars of this type is fewer than 6 cm. in diameter, and is less than 1cm. in depth. Mortars of this type contained the stains of various pigments; red and black were the most common colors (Fig. 44,*c*). Ten examples of this type were excavated. One mortar of this type was found which exhibited two worked depressions. One cavity contained black pigment; the other was stained from a red pigment (Fig. 45,*b*). In addition to these specimens, three were found containing a pecked depression of this size, but showed no signs of smoothing or use (Fig. 44,*a*).

The second type of mortar has a significantly larger depression worked into the surface of the tool. The diameter of the cavity of this type is greater than 7 cm. and is relatively deep, greater than 1.5 cm. Interestingly, there was no trace of pigment found on mortars of this kind. Eight mortars of this type were found (Fig. 44, *b*).

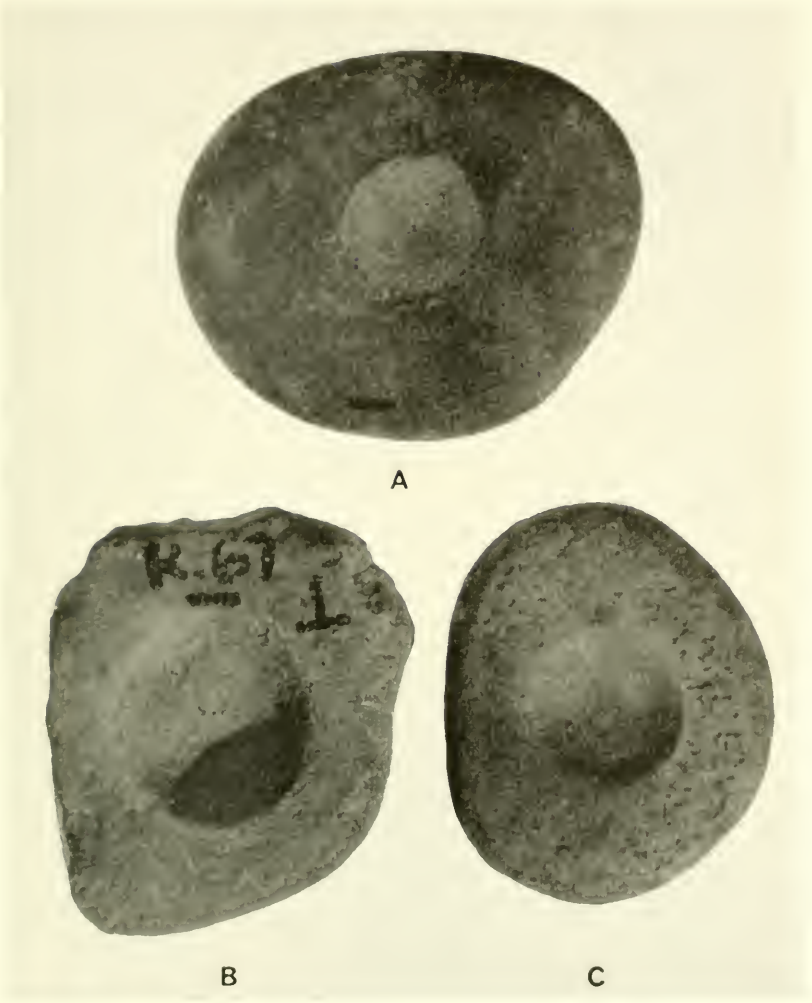

Fig. 44. Mortars. Length of *c* is 17.5 cm.

A functional inference may be made after the class labeled mortars is segregated into two major types based on size differences of the worked depression. The presence of pigment on the examples of the first and smaller type would seem to indicate their use in the processing of pigments. Reducing lumps of pigments to a fine powder prior to mixing with a liquid vehicle is the inferred use of artifacts of this type (see paint palettes, pp. 64–66, below). The mortars of the second type were not used for grinding pigments, but their exact use is not known. They probably

were utilized for a variety of tasks, including the crushing of seeds and other foodstuffs, as well as clay and temper for pottery manufacture.

Two bedrock mortars were found between outliers one and two at the site (Fig. 1). These are probably associated with the Pueblo, but it is impossible to demonstrate this.

Type I mortars are what Rinaldo (Martin *et al.*, 1964b, pp. 70–71) refers to as "rough block mortars with a shallow cup." They are similar to what Woodbury (1954, p. 113) terms grinding slabs. Significantly, Woodbury (*ibid.*) reports stains from pigments on these items and infers a function of processing paints for them.

Pestles.—A total of 11 pestles was excavated at the Broken K site. These items were shaped to some degree. They are smoothed, cylindrically-shaped stones with one or both ends worn from use. This class, like the mortars, is divided into two major types on the basis of metric attributes.

The first type consists of the smaller pestles, 7–9 cm. in length and less than 8 cm. in diameter. There were eight pestles of this type recovered (Fig. 46*a–c*).

The second type is a larger implement, greater than 10 cm. in length and more than 6 cm. in diameter. Only three examples of this type were found.

The pestles recovered from the Carter Ranch Site were much larger, on the whole, than those from Broken K (Martin *et al.*, 1964b, p. 68). There is no apparent functional reason explaining this difference in size. Style change reflecting a temporal difference would not seem to be an adequate explanation as sites of a comparable age and more recent date in this area have produced pestles of larger size, similar to those from the Carter Ranch Site (Martin and Rinaldo, 1960b, pp. 243 and 247; Martin, Rinaldo, and Longacre, 1961*a*, p. 71, Fig. 41).

Paint Palettes.—Eleven paint palettes were found at the Broken K site. All but one of these was made of stone; one was simply a large sherd. The stone palettes were shaped and smoothed to create a flat or nearly flat surface for the purpose of mixing pigments with a liquid vehicle, or to otherwise process paints. All specimens contained the remains of pigments. This class of items is segregated into the following types:

Type I: Irregular stone cobble or slab with a large, shallow circular depression worked into one surface, with steep, angular sides. Six of this type were recovered (Fig. 45, *a*). In addition, one example of this type was found which contained three circular depressions in a single slab.

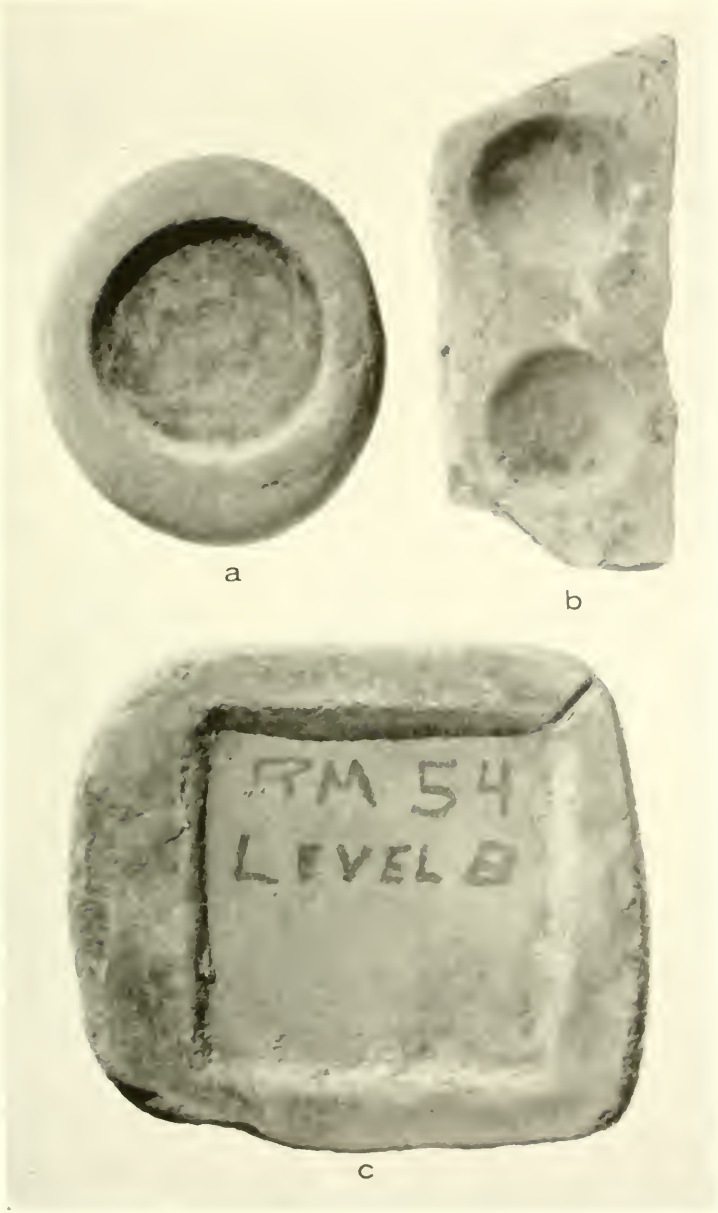

Fig. 45. Paint palettes (*a* and *c*) and double mortar. Length of *c* is 21.9 cm.

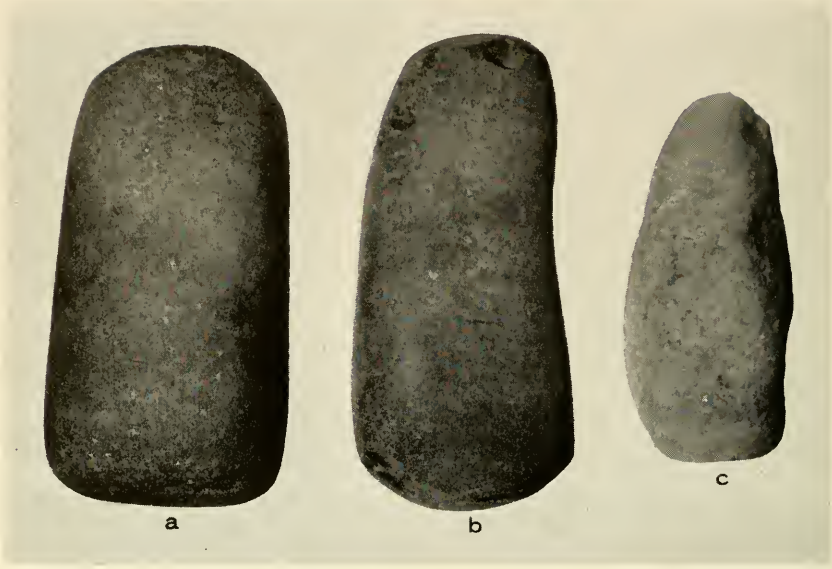

Fig. 46. Pestles. Length of *c* is 7.3 cm.

Type II: Shaped rectangular slab with a square depression worked into one surface which is well-smoothed. In the single example of this type found at Broken K Pueblo, there is a narrow and deep groove or trough worked into one corner to facilitate the pouring of a liquid from the palette into a container (Fig. 45, *c*). It is similar to one illustrated by Woodbury (1954, Fig. 23, *a*) from Awatovi, Pueblo IV date.

Type III: Thin, rectangular slab of sandstone, one area of surface smoothed. Two palettes of this type were found. These are similar to items called "lapstones" by Rinaldo found at Table Rock Pueblo (Martin and Rinaldo, 1960b, p. 249).

Type IV: Large, shallow jar sherd (Snowflake black-on-white, Carterville variety) with the interior covered with pigment. No smoothing is apparent. Only one example of this type was found.

The stone palettes differ from the mortars (pp. 62–64, above) in that the depressions are angular with relatively flat bottoms. All specimens contained pigment; red and black were the only two colors noted.

Polishing stone.—Only two items that could be called polishing stones were recovered. These are small, unaltered stream pebbles which were smoothed from use forming one or more facets. A large number of small, smooth pebbles were found at the site, but they were discarded in the field.

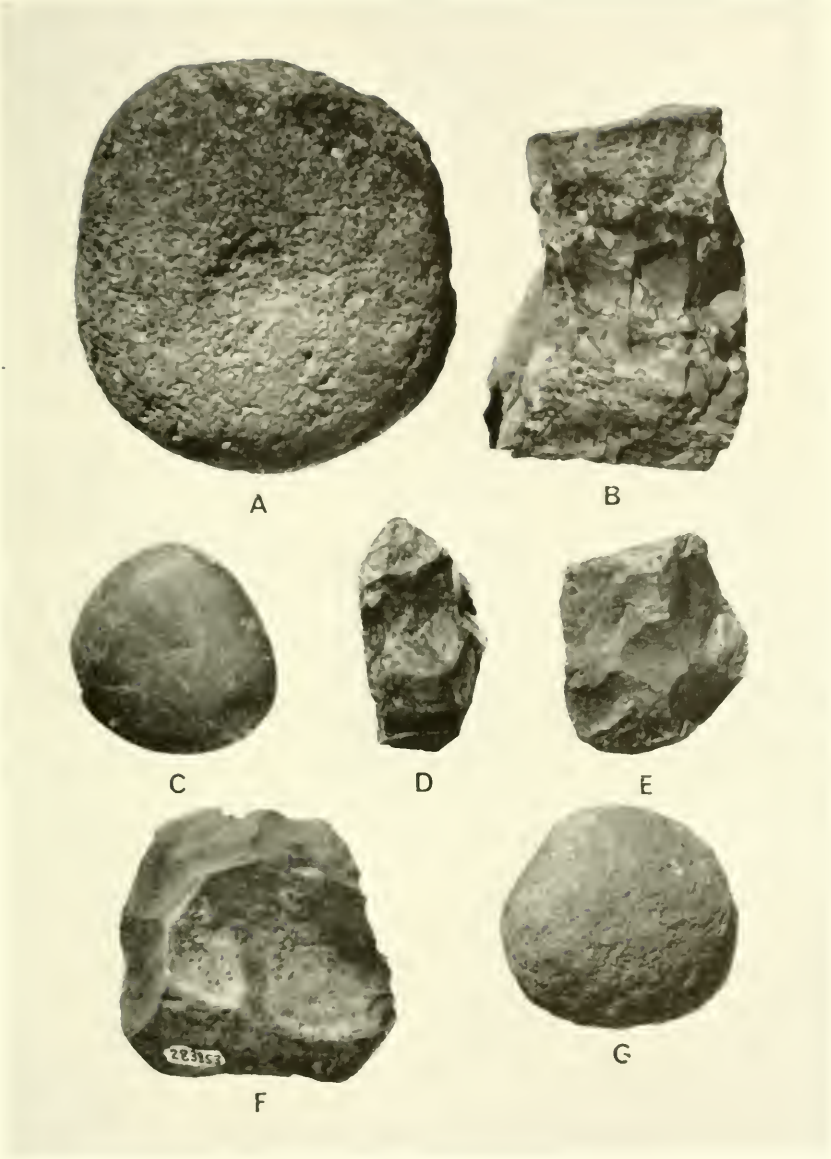

Fig. 47. Hammerstones (*a*, *c*–*e*, *g*), chopper (*f*), and block core with knife worked on one edge (*b*). Length of *f* is 7.8 cm.

Rubbing stone.—These items are shaped stones with one or two faces smoothed from use. It is possible to divide this class into three types on the basis of size, shape, and material.

Type I: Large, smooth stream cobble which is worked into rectangular shape. Two examples were found.

Type II: Similar to Type I in size and shape, made from a fine-grained sandstone with edges squared and smoothed. Four of this type were recovered.

Type III: Large oval cobble, carefully smoothed and shaped with all specimens showing evidence of battering on their edges as well as use in smoothing. Three of this type were excavated at this site.

The polishing and rubbing stones are essentially similar to those recovered from the Carter Ranch Site (Martin *et al.*, 1964b, pp. 67–68) and are not illustrated herein (*ibid*, fig. 29, p. 69).

Hammerstones.—A total of 247 artifacts of this class were recovered in the excavation of Broken K Pueblo. The class was divided into three major types as follows:

Type I: Unmodified stream pebbles, smooth and water worn, with one or more surfaces or edges showing scars and flaking resulting from battering. They are irregular in shape, ranging in size from 2 cm. in diameter and 5 cm. in length to the largest examples that tend to spherical shape with diameters approaching 20 cm. A total of 133 examples of this type was found (Fig. 47, *c* and *g*).

Type II: Similar to Type I in that these hammerstones consist of stream pebbles, but they are modified with small pecked depressions on two surfaces, probably to serve as finger grips. Nine specimens of this type were recovered (Fig. 47, *a*).

Type III: Exhausted core nuclei or workable core nuclei utilized as hammerstones as evidenced by battered edges or surfaces or both. A total of 105 was found (Fig. 47, *d* and *e*).

Hammerstones are among the most frequent artifacts recovered from prehistoric sites, in the Southwest as well as other parts of the world. Their frequency reflects their importance to a people dependent upon the use of lithic tools. Hammerstones are probably one of the most important items in the stone knapper's tool kit. Generally, their importance as tools for chipping flint has not been recognized in the Southwest (e.g., Woodbury, 1954, pp. 92–93). Various uses have been suggested for these items including the pecking of stone as part of the shaping operation for such items as metates, axes, and others. This is undoubtedly an important function of these numerous implements. Another use for these tools has

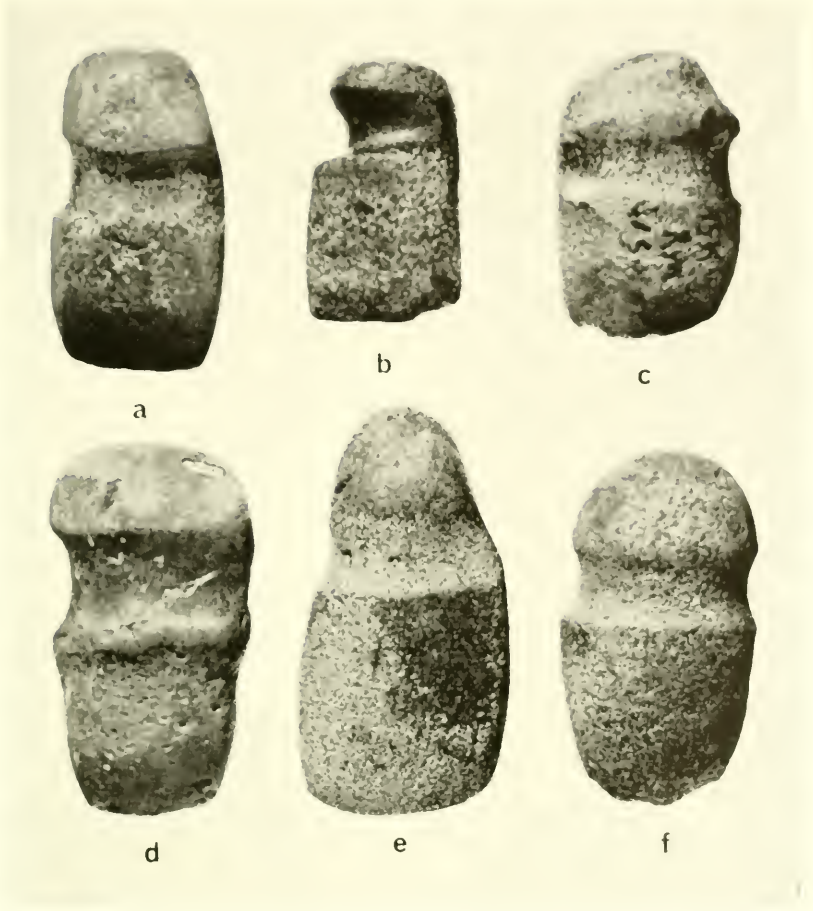

Fig. 48. Stone axes. Three-quarters grooved, *a–d;* unfinished three-quarters grooved, *e;* full-grooved, *f*. Length of *f* is 14.5 cm.

been suggested (Woodbury, 1954, p. 93)—the pecking of grinding surfaces of milling tools to roughen them for more effective grinding. This suggestion is supported by the presence of hammerstones at the Broken K Site in association with mealing bins in rooms 7, 33, 82, and 92. The interested reader is referred to Woodbury's excellent discussion of hammerstones (*ibid*, pp. 85–93) from the prehistoric Southwest.

The use of stream cobbles as well as core nuclei for hammerstones appears to be fairly common in the Southwest. Both forms were found at the Carter Ranch Site (Martin *et al.*, 1964b, pp. 72–73). Wheat (1954, pp. 125–127) reports similar types from the Point of Pines area.

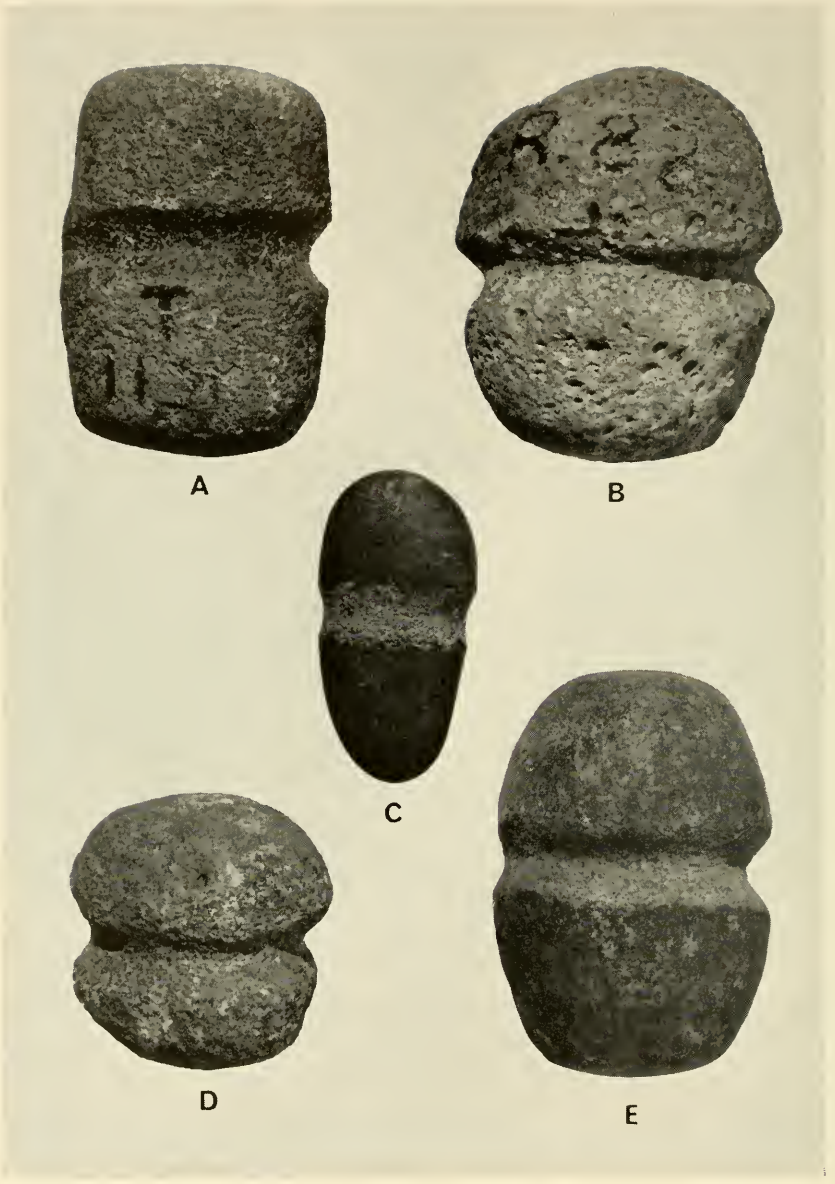

Fig. 49. Mauls. Three-quarters grooved, *a;* full-grooved, *b–e*. Length of *c* is 10.5 cm.

Worked Slabs.—A number of shaped sandstone slabs were recovered from this site. Several classes of this category can be listed, but no attempt has been made to further segregate these items into types. The classes are as follows:

Ring slabs: These are large (ca. 30–60 cm. across), square to circular slabs with circular holes worked into the center. They probably served as vent and hatchway capstones. Four were found at the site.

Circular slabs: Two roughly circular slabs were found in association with a floor pit in room 53. They probably served as covers for the pit.

"Floor smoothers": These are rectangular in outline with roughly trimmed edges. The surfaces vary from rough to smooth, possibly from use. They range in size from about 6 by 10 cm. to 25 by 40 cm., and in thickness from 1.5–3.5 cm. Their regular shape and smoothed surfaces suggest a use in household activities such as floor smoothing or as an implement useful in plastering floors or walls. A total of 42 of these items was found.

Grooved-perforated slabs: Two examples of grooved slabs were found, one of which had a hole drilled through its center. Both were roughly rectangular in outline; the drilled specimen had a shallow groove pecked from the central hole to the edge, longitudinally. The other had a shallow groove pecked in one surface, from end to end. Their use is unknown.

Painted slab: One example of a painted slab was found. It was approximately rectangular in outline with rough edges and unsmoothed surfaces. On one surface was barely visible a geometric design painted in black.

Axes.—Thirteen axes of various types were excavated at this site. By far the most common types were the three-quarters grooved forms. The nomenclature proposed by Woodbury (1954, pp. 25–26) is used here.

Type I: Three-quarters grooved, no lip around groove. Three specimens with a smoothed, flat inner side (Fig. 48, *a* and *b*), and one example with a rounded, rough inner side were found.

Type II: Three-quarters grooved with a lip around the groove. All five examples of this type had a smoothed, flat inner side (Fig. 48, *c* and *d*).

Type III: Full-grooved; two examples found (Fig. 48, *f*).

Type IV: Grooved on two faces only; "one-half grooved axe." Only one example found.

Type V: Unfinished three-quarters grooved axe. One specimen found which is shaped through pecking but is not polished (Fig. 48, *e*).

The high number of three-quarters grooved axes at this site supports Rinaldo's suggestion (Martin *et al.*, 1964b, p. 74) that this form appears

to be typical of the later Little Colorado ruins, although earlier (1959, p. 284) he suggests that the full-grooved axe is typical of the "Zuni area." In general, the three-quarters grooved axe appears to have spread from the Hohokam area northward. Woodbury (1954, pp. 25–42) presents an excellent discussion of typological considerations, distribution, and inference regarding axes from the prehistoric Southwest.

Mauls.—Thirteen grooved mauls were recovered. They range in size from relatively small (Fig. 49, *c*) to fairly large and heavy (Fig. 49, *e*). There are two basic types:

Type I: Full-grooved. The most common type (11 found) covering the entire range of size (Fig. 49, *b–e*).

Type II: Three-quarters grooved. Only two examples found (Fig. 49, *a*).

Unlike axes, the most common form of mauls in the upper Little Colorado area appears to be the full-grooved type. There were no recognizable examples of re-used axes as mauls at this site. As he does for axes, Woodbury (1954, pp. 43–49) presents an excellent discussion of mauls from the prehistoric Southwest.

Arrow-Shaft Tools.—Fifty-one arrow-shaft tools were recovered from Broken K Pueblo. They were produced on a stone cobble or on a reworked mano. All have certain features in common: smooth, flat bottom, and one or more smooth grooves worked into the upper surface (the groove is polished and generally blackened). Some had ridges worked into the upper surface, and four had red pigment adhering to them. The following typology is based on attributes such as the presence or absence of ridges and the nature of the surface containing the groove.

Type I: One transverse groove on a surface that is worked flat or nearly so. No ridge is present. The outline of the tool is either oval or rectangular in about equal frequency. Thirteen examples of this type were found (Fig. 50, *h*).

Type II: Single transverse groove worked into a rounded and smoothed pebble. This is comparable to Rinaldo's "Truncated Triangular Type" (Martin *et al.*, 1964b, p. 77). There is no ridge present. All but two examples were sub-triangular in outline; one was oval in shape and the other rectangular. Fifteen examples of this type were recovered (Fig. 50, *f*). One variation of this type was recorded; this was a single example of this type with three parallel, transverse grooves (Fig. 50, *g*).

Type III: One transverse groove worked into a rounded and smoothed surface. A single ridge is worked as a "lip" on one side of the groove and parallel to it. All four specimens of this type were sub-triangular in outline (Fig. 50, *e*).

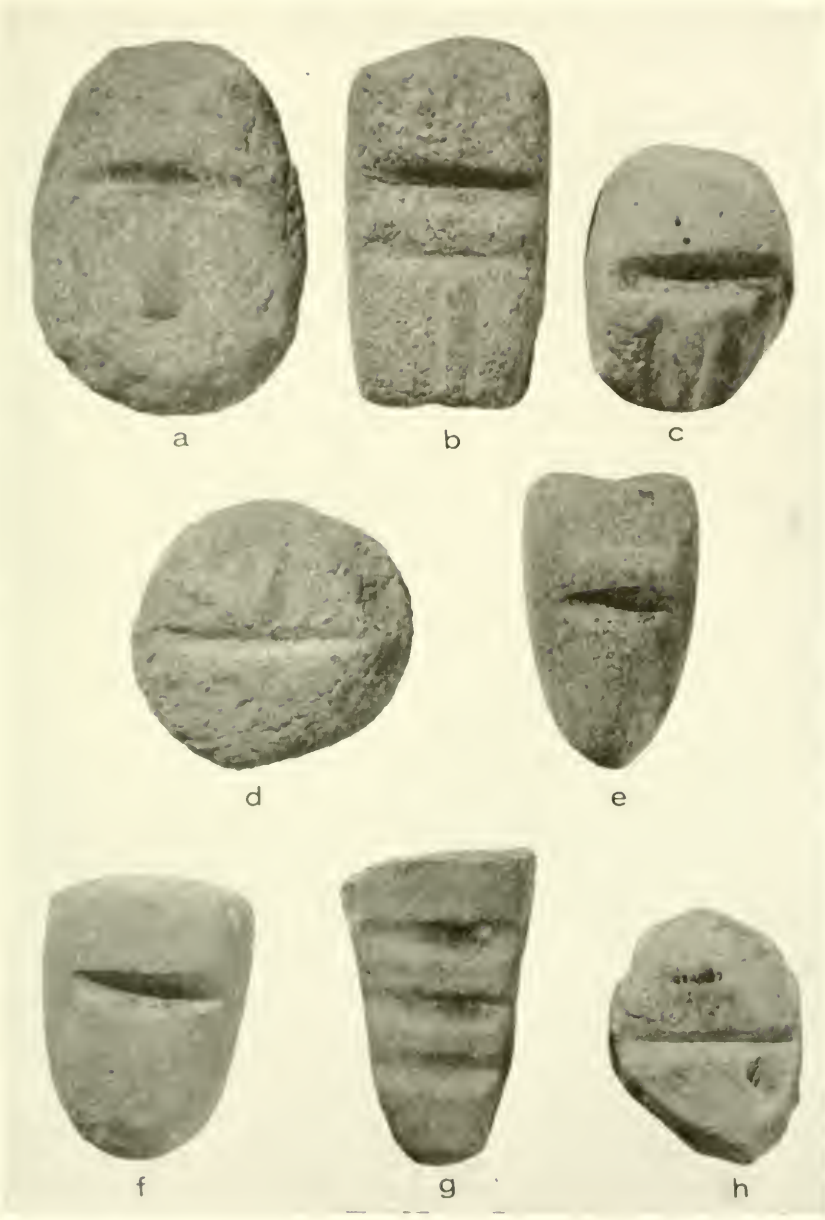

Fig. 50. Arrowshaft tools, transverse groove types. Length of *h* is 6.9 cm.

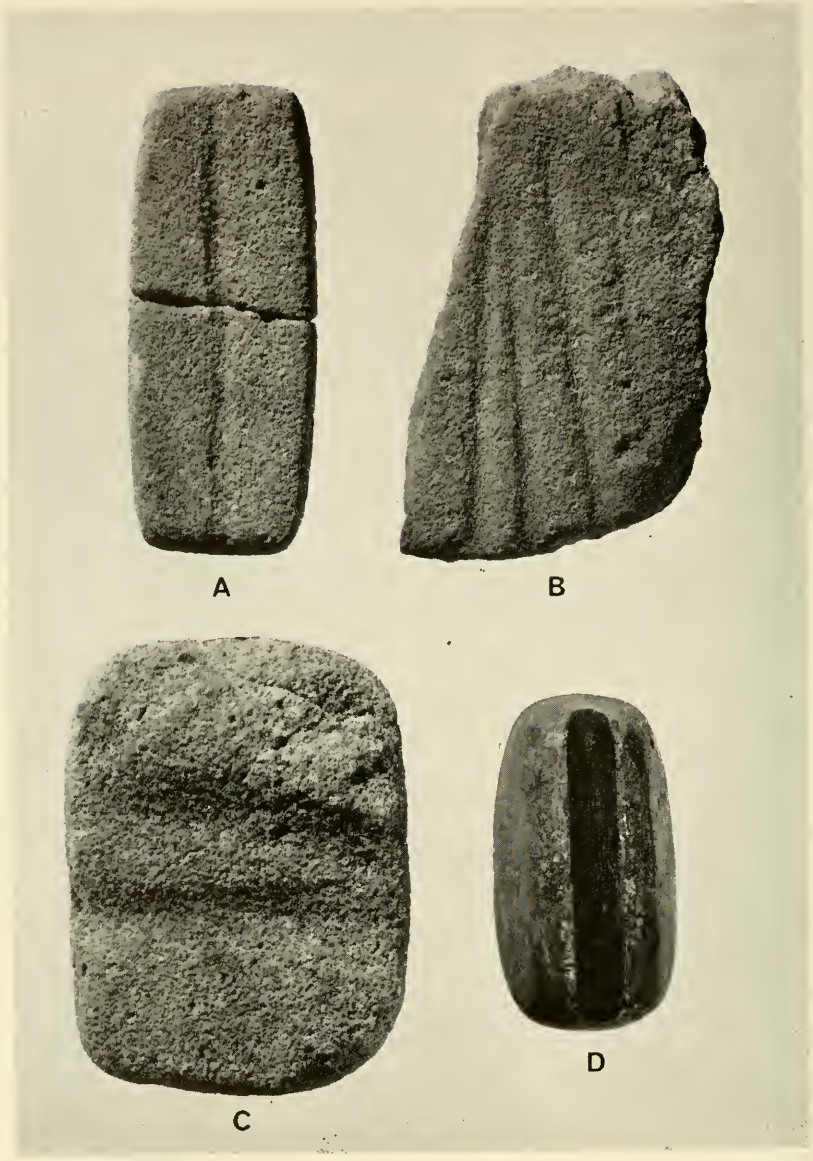

Fig. 51. Simple grooved abraders (*a–c*) and polished and incised arrowshaft tool, longitudinal grooved type, (*d*). Length of *d* is 8.6 cm.

Type IV: One transverse groove worked into a rounded to flat surface. There is a single ridge perpendicular to the groove. The ridge is poorly defined and short (4.5–5 cm.). All six examples have oval outlines (Fig. 50, *d*).

Type V: One transverse groove with a single ridge perpendicular to the groove. The ridge is well-defined and long (5.5–6.5 cm.) and is worked onto a plane which meets the flat surface containing the groove at about an angle of 30 degrees. The outline varies among oval, rectangular, and sub-triangular forms. Six examples of this type were found (Fig. 50 *c*).

Type V-b: Essentially similar to Type V-a except that both the transverse groove and the perpendicular ridge are made on the same, flat surface. Only one such tool was found (Fig. 50, *a*).

Type V-c: Same as Type V-a except there are two, parallel transverse grooves. One example of this type recovered (Fig. 50, *b*).

Type V-d: Essentially the same as Type V-a except that there is a ridge parallel to the groove as a "lip" in addition to the perpendicular ridge. Two examples were found.

Type VI: Single groove worked into the longitudinal axis of a carefully shaped and polished stone. There is a cross-hatchured design incised on the ends, sides, and top surface of the single example found of this type (Fig. 51, *d*).

In addition to these specimens, one fragment of an arrowshaft tool that was too small to type with any accuracy was recovered.

Pointing out the experiments conducted by Cosner (1951, pp. 146–147), Rinaldo suggests that these tools were used to straighten arrow shafts of reeds (Martin *et al.*, 1964b, p. 77). It is possible, of course, that additional uses were made of these tools, and some not involving arrow shafts at all (e.g., preparing ritual items such as pahoes or spindles, etc.). Woodbury (1954, p. 101 and pp. 108–110) suggests the term "shaftsmoother" for these items. His arguments point to the multifunctional nature of these tools. A possible typological sequence is suggested by Rinaldo (Martin *et al.*, 1964b, p. 78).

Simple-Grooved Abraders.— These are generally rectangular blocks of coarse-grained sandstone with one or more grooves worked into one surface. Three examples were recovered at the Broken K Site. One has a single longitudinal groove (Fig. 51, *a*). Another has two transverse grooves (Fig. 51, *c*). Rinaldo documents their apparent late distribution in the Southwest (Martin *et al.*, 1964b, p. 78).

Stone Pipes.— Two pipes and an undrilled "pipe-blank" were recovered from Broken K Pueblo. All three are sub-conical in shape. One is a

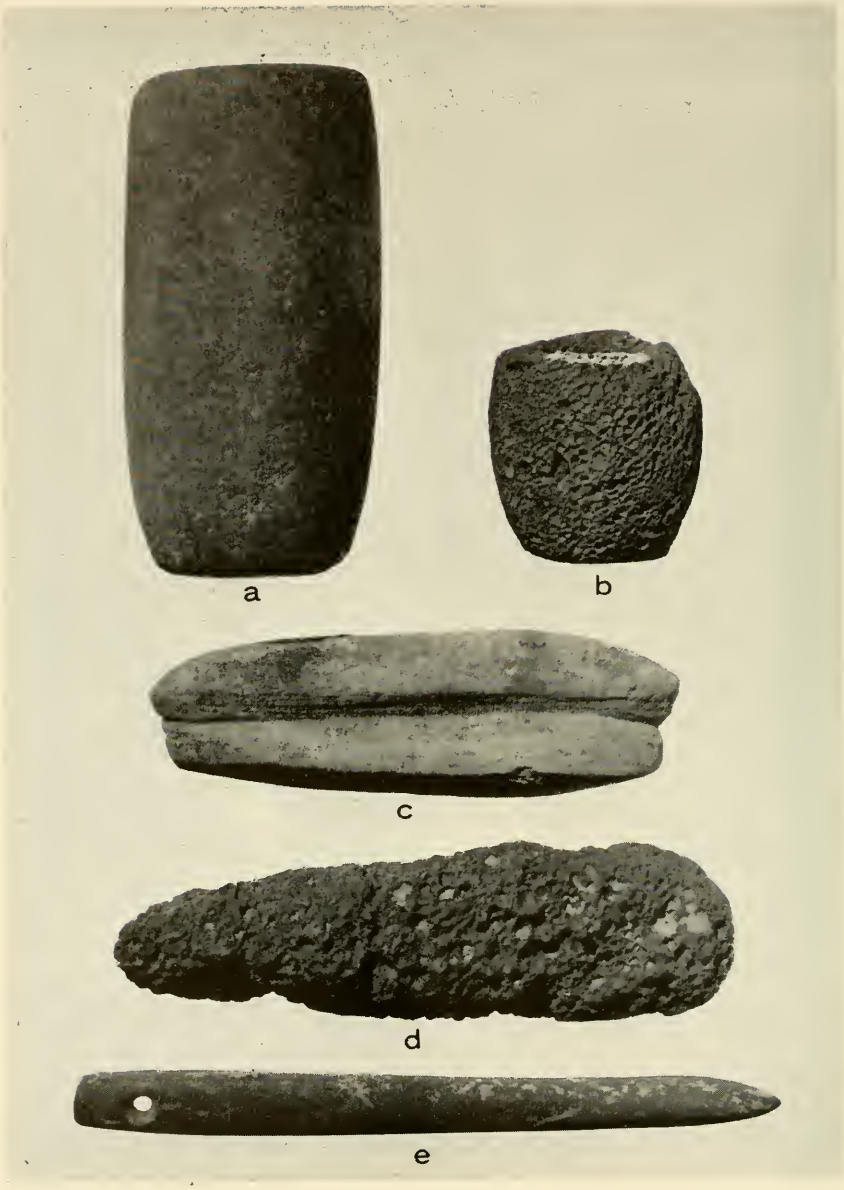

Fig. 52. Miscellaneous stone artifacts. Pipe blank, *a;* pipe, *b;* irregular piece of sandstone with groove, *c;* "medicine cylinder", *d;* stone "needle", *e*. Length of *e* is 11.6 cm.

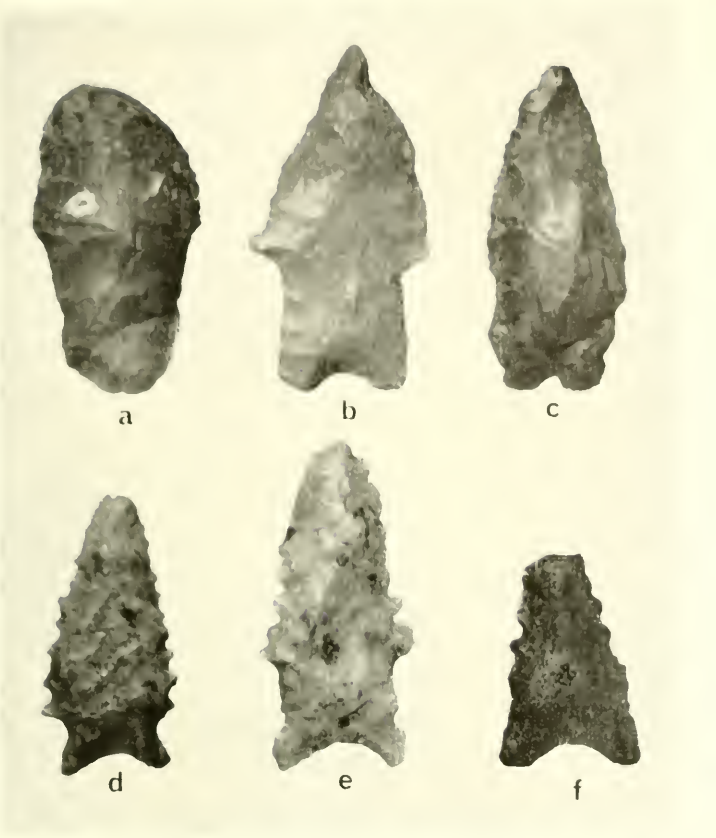

Fig. 53. Projectile points, Miscellaneous types. Length of *f* is 2.8 cm.

small pipe made of vesicular basalt (Fig. 52, *b*). The other two are somewhat larger in size and made from a fine-grained stone (Fig. 52, *a*).

CHIPPED STONE

Projectile Points.—For typological convenience, this class has been divided into three groupings. First are described those projectile points which, stylistically, are associated with sites utilized during the preagricultural occupation of the region. These are sites of the regional manifestation of the Desert Culture in our area, known as the Concho Complex (Martin *et al.*, 1962, pp. 155–164; fig. 69, p. 158). Projectile points of these styles were found in surprising abundance at this late pueblo site (21 points). Because almost all of them were found in floor association

or in the fills of abandoned rooms, it is probable that these early points were collected by the inhabitants of Broken K Pueblo and brought to the village. There was no evidence of an earlier, Desert Culture occupation of the site. This interpretation is supported by the complete lack of other artifacts stylistically associated with the Concho Complex. This situation prevailed at the Carter Ranch Site as well (Martin *et al.*, 1964b, p. 84).

The second grouping consists of eight fairly large corner-notched and side-notched projectile points, stylistically associated with pit-house communities dating prior to roughly A.D. 800. These, too, were found in floor and fill context at the site. It is possible that these points were collected from earlier sites in the area and brought to Broken K at the time of its occupation. It is probable, however, that points of this style are associated with an earlier component underlying the major occupation of this site. Portions of two pit houses were excavated beneath the pueblo, and early ceramic types were found (cf. Chap. IV).

The third grouping consists of the smaller, triangular projectile points, stylistically associated with sites post-dating ca. A.D. 800 in much of the Southwest. It is felt that these points represent the types actually made during the occupation of Broken K Pueblo. It is this group of points that is the most numerous (31 points).

Group I: Projectile points stylistically associated with the Concho Complex (Fig. 53). Numbers in parentheses refer to quantity found at Broken K Pueblo.

Type I: (2) Expanding stem, indented base, serrated blade, barb at corners of base (Fig. 53, *d* and *e*).

Type II: (2) Triangular, indented base, serrated blade (Fig. 53, *f*).

Type III: (1) Straight stem, indented base, barb at base of blade (Fig. 53, *b*).

Type IV: (1) Expanding stem, straight base.

Type V: (1) Straight stem, notch in base (Fig. 53, *c*).

Type VI: (1) Contracting stem, excurvate base (Fig. 53, *a*).

Type VII: (1) Contracting stem, straight base.

Type VIII: (1) Contracting stem, indented base.

Type IX: (1) Expanding stem, indented base.

Type X: (1) Side notched, straight base.

Type XI: (1) Side notched, excurvate base.

Type XII: (1) Triangular, indented base.

Indeterminate Fragments: (6)

Fig. 54. Projectile points, miscellaneous types. Length of *g* is 4.2 cm.

Group II: Larger notched forms, stylistically associated with pit house sites, ca. A.D. 200–800 (Fig. 54). Numbers in parentheses refer to frequency of occurrence for each type at Broken K Pueblo.

Type I: (1) Corner notched, straight base (Fig. 54, *f*).

Type II: (2) Side notched, straight base (Fig. 54, *a—reworked*).

Type III: (1) Corner notched, excurvate base (Fig. 54, *b*).

Type IV: (1) Side notched, indented base (Fig. 54, *d*).

Type V: (1) Expanding stem (Fig. 54, *b*).

Type VI: (1) Corner notched, serrated blade (Fig. 54, *g*).

Type VII: (1) Side notched, excurvate base, serrated blade (Fig. 54, *c*).

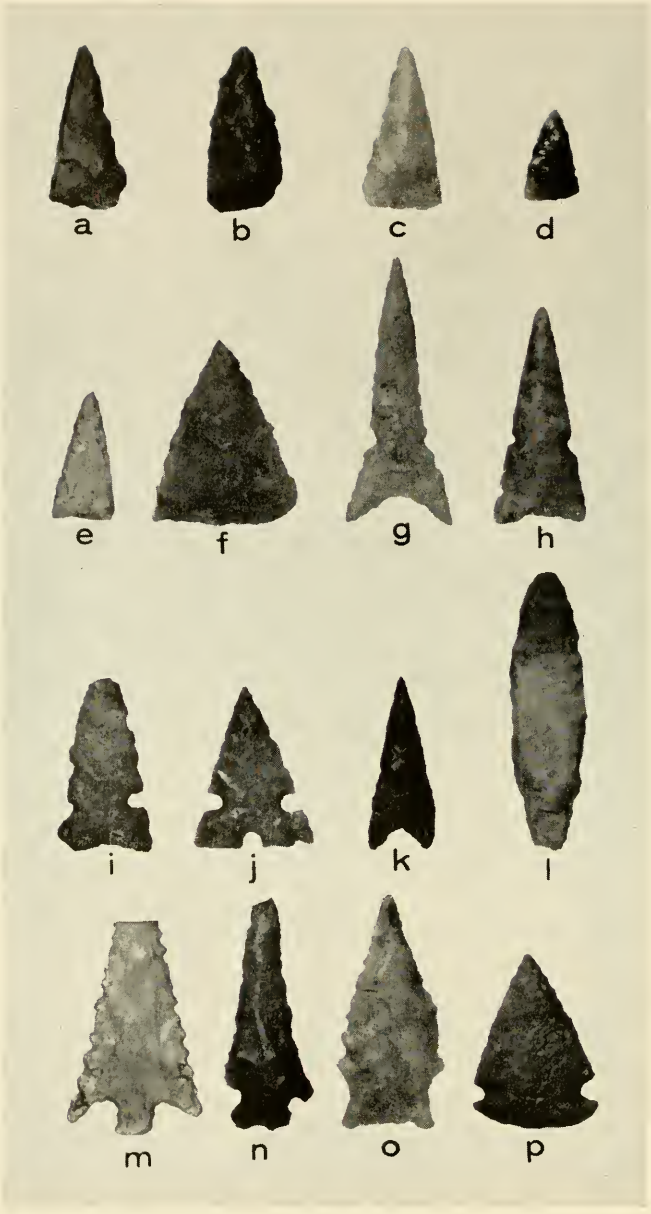

Fig. 55. Projectile points, miscellaneous types. Length of *p* is 2.1 cm.

Group III. Small, generally triangular forms, associated with pueblo sites dating ca. A.D. 800 and later. Numbers in parentheses refer to frequency of each type at the site.

Type I: (2) Triangular, side notch, basal notch (Fig. 55, *j*).

Type II: (1) Triangular, side notched, excurvate base (Fig. 55, *p*).

Type III: (2) Triangular, double side notched, indented base (Fig. 55, *h*, *o*).

Type IV: (2) Triangular, indented base, side notched (Fig. 55, *g*).

Type V: (10) Triangular, straight base (Fig. 55, *a–f*).

Type VI: (5) Triangular, indented base (Fig. 55, *k*).

Type VII: (2 fragments) Straight stemmed, triangular blade.

Type VIII: (1) Triangular, straight stem, serrated blade (Fig. 55, *m*).

Type IX: (1) Triangular, corner notched (Fig. 55, *n*).

Type X: (1) Triangular, expanding stem, straight base (Fig. 55, *o*).

Type XI: (1) Leaf-shaped, contracting stem (Fig. 55, *l*).

Type XII: (1) Diamond shape, side notch.

Indeterminate fragments: (1).

In his discussion of the projectile points from the Carter Ranch Site, Rinaldo (Martin *et al.*, 1964b, p. 84) presents some interesting observations. He notes the presence of the small, triangular points at Southwestern sites after about A.D. 900. He suggests the presence of lateral notches about half the distance from the point to the base may be diagnostic of later sites in the Southwest. A total of 19 such points were found at Carter Ranch. The small number of projectile points with this characteristic found at the Broken K Site suggests that this particular style was relatively short-lived. The most numerous type at Broken K Pueblo was a simple triangular shape with a straight base. The presence of small, side-notched, triangular points with a well-defined basal notch may indicate some level of interaction with the Jeddito area. This particular form is one of the most abundant in that region after about A.D. 1100 (Woodbury, 1954, p. 121).

Drills.—A total of twelve drills or fragments was recovered from the excavations at Broken K. All were produced on flakes, and were bifacially worked.

Type I: Square or curved base, parallel sides. Three examples of this type were found (Fig. 56, *d*, *e*, and *g*).

Type II: Flaring or expanding base. Five of this type were recovered (Fig. 56, *b*, *c*, and *f*).

Type III: Broad flake with a drill or punch worked into one end. One specimen was found (Fig. 56, *a*).

Three fragments of drills were found which were too small to assign to a type.

The drills from Broken K are similar typologically to those from the Carter Ranch Site (Martin *et al.*, 1964b, p. 86). In addition, their rela-

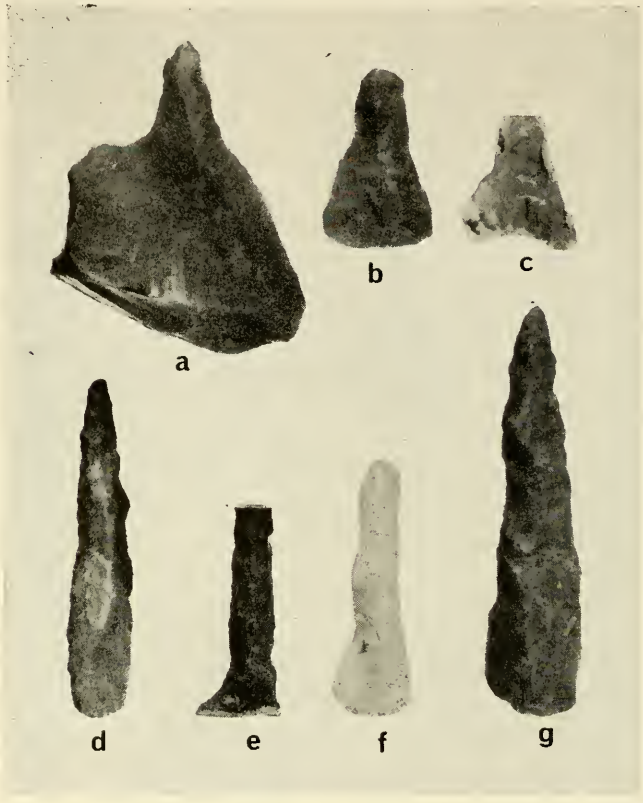

Fig. 56. Drills and punches. Punch, *a;* drill with flaring base, *b*, *c;* drill, *d–g*. Length of *g* is 5.4 cm.

tive frequency compared to other items such as projectile points was low at both sites.

Saws.—Ten saws were recovered at the Broken K site. Most of these consisted of irregular flakes with several deep notches worked into one or more edges.

Type I: Irregular flakes with regularly-spaced deep notches on edges. Nine examples were found (Fig. 58, *a*, *c*, and *d*).

Type II: Reworked knife, leaf-shaped, with notches regularly spaced on one side. Only one was recovered (Fig. 58, *b*).

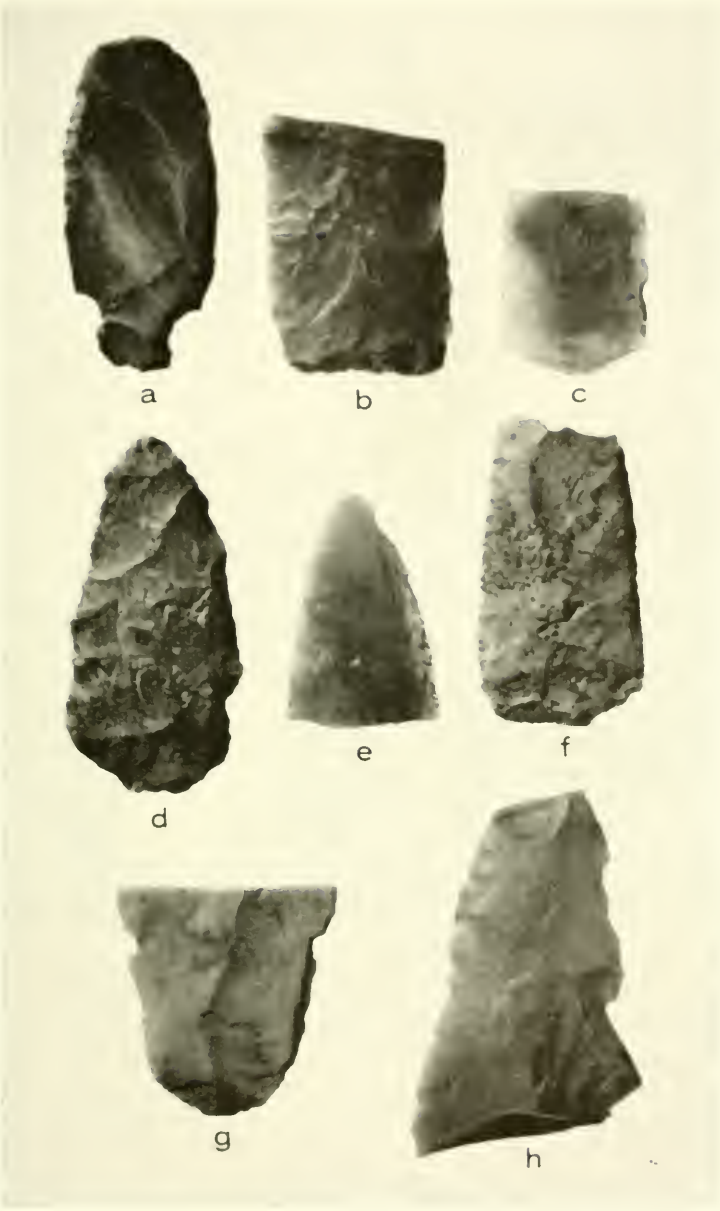

Fig. 57. Knives. Length of *a* is 5.3 cm.

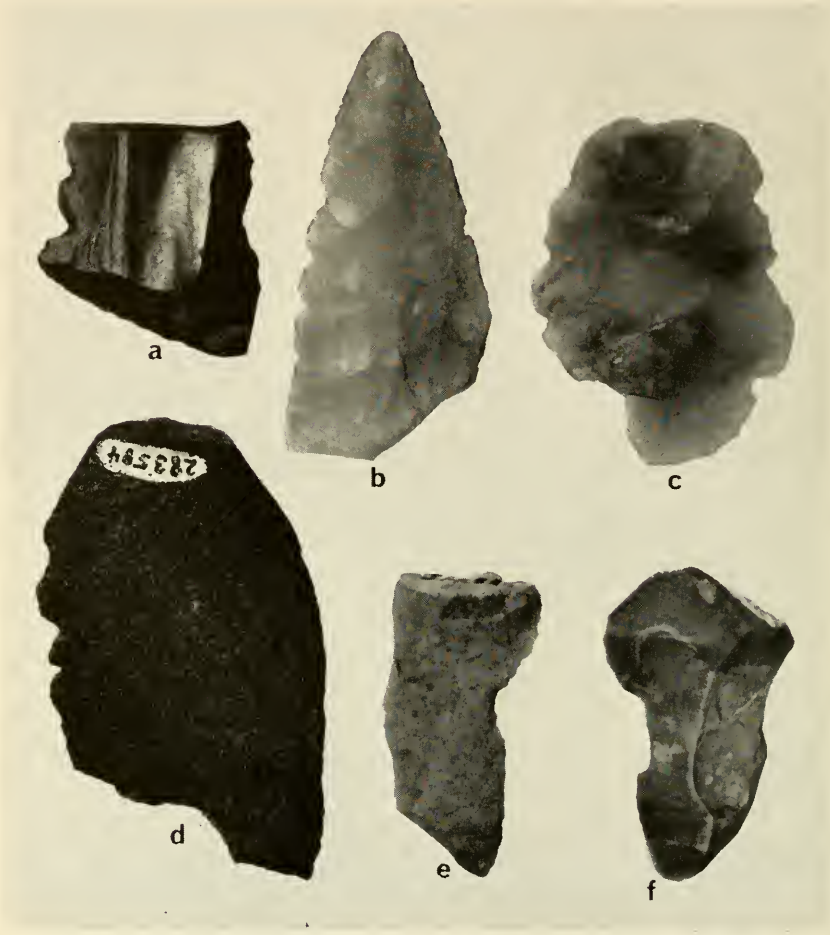

Fig. 58. Saws (*a–d*) and notched side scrapers (*e* and *f*). Length of *f* is 4.2 cm.

Similar items occurred in much greater frequency at the Carter Ranch Site (Martin *et al.*, 1964b, pp. 86–87). The marked decrease in quantity may have temporal significance and perhaps points to a functional change in the nature of the tool-kit after about A.D. 1200. Rinaldo (Martin *et al.*, 1964b, pp. 86–87) presents a summary of the distribution of saws in the Southwest and suggests some possible uses.

Gravers.—Twenty engraving tools were found at this site. All were produced on flakes or "shatter", and all were single-point gravers.

Type I: Small, irregular flake with a chisel-like point worked into one end. Two examples of this type were recovered (Fig. 59, *h* and *i*).

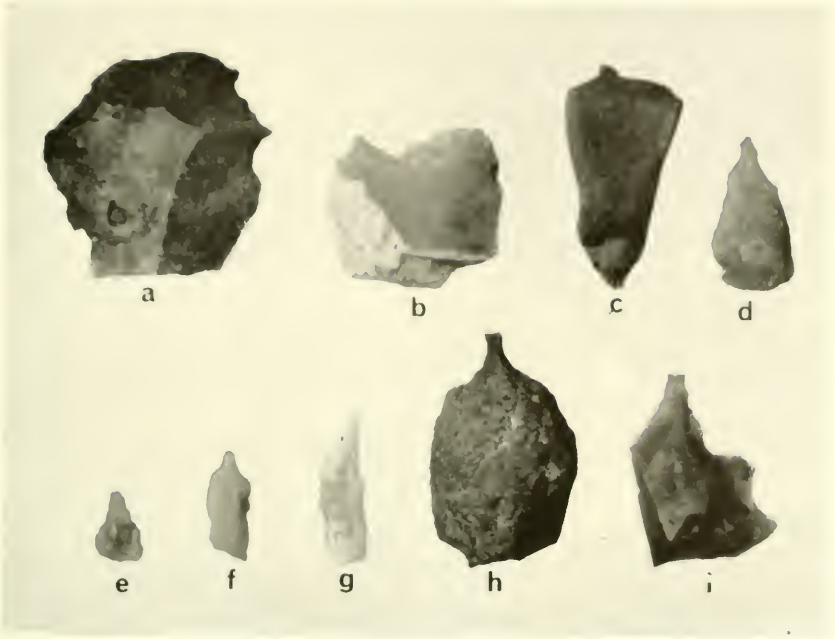

Fig. 59. Graving tools. Gravers, *a–d*, *g–i*; micro-gravers, *e* and *f*. Length of *i* is 2.5 cm.

Type II: Small, sharp graving point worked on broad flake or small piece of shatter. Length of the flake varied from 2.5–4.2 cm. with a mean length of 3.3 cm. Twelve of this type were found (Fig. 59, *a–d* and *g*).

Type III: Microgravers—small narrow flakes with a small graving point worked into one end. Flake length varies from 1.0–2.3 cm.; mean length is 1.9 cm. Six examples were found (Fig. 59, *e–f*).

Utilized Flakes.—This class of artifact was one of the most numerous recovered at Broken K. It consists of all flakes, including shatter, showing no regular and purposeful retouch, but exhibiting irregular chipping resulting from use. A total of 226 of these sharp-edged flakes showing signs of use was recovered. They ranged in size from about 1 to 9 cm. in length and from about 1 to 7 cm. in width. Their frequency in terms of shape categories is presented in graphic form in Figure 60.

Rinaldo (Martin *et al.*, 1964b, p. 88) lumped the utilized flakes from Carter Ranch with the flake knives, showing purposeful retouch. I will not follow this classification for reasons that will be made clear.

Flake Knives.—This class of items consists of all flakes which have been purposely modified to form one or more acute cutting edges. They are

retouched, generally bifacially, but the shape of the flake is unmodified. A total of 106 flake knives was found at the site. This class is divided into the following two types:

Type I: These are flakes struck from a prepared core surface—the Levallois Technique. Fifteen examples were recovered from the site (Fig. 61, *a–g*). The shape of the flake was predetermined by removing smaller flakes from the surface of the core and by preparing a striking platform. The more classic examples of the Levallois Flake tend to be somewhat oval in shape (Fig. 61, *f* and *g*).

Type II: These are random flakes and pieces of shatter with retouched edges. A total of 88 of these tools was found (Fig. 62, *a–o*). All types of flakes were represented in this collection, including expanding, contracting, and irregular flakes, as well as both primary and secondary decortication flakes (White, Binford, and Papworth, 1963, p. 5). The flakes varied in length from 1.5 to 8.0 cm., and in width from 1.0 to 7.0 cm. The frequencies of occurrence of the length and width dimensions are shown in Figure 63.

Blades.—A caution is mandatory at this point as I am departing from Rinaldo's use of this term in his typology (Martin *et al.*, 1964b, p. 84). Rinaldo uses this term to refer to bifacially-worked, leaf-shaped artifacts. In adopting this term he follows many workers in the Southwest (cf.

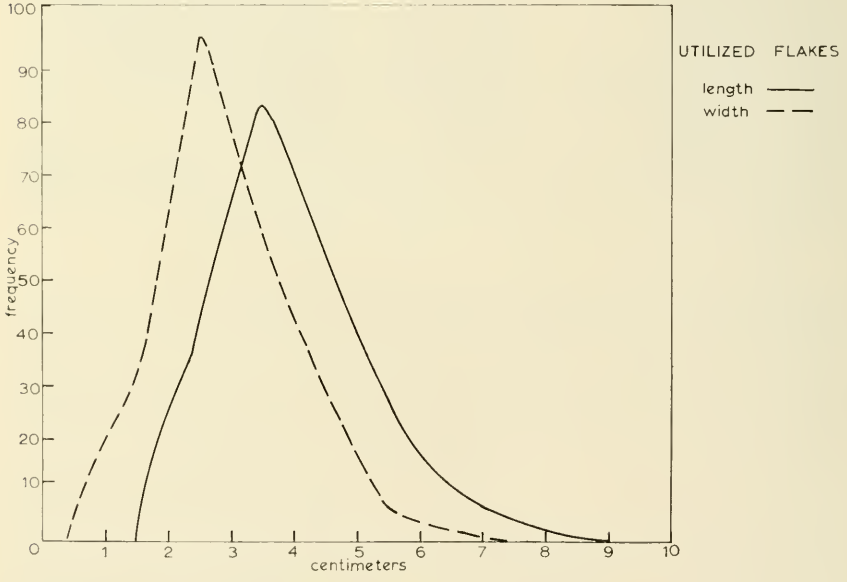

Fig. 60. Distribution of dimensions of utilized flakes.

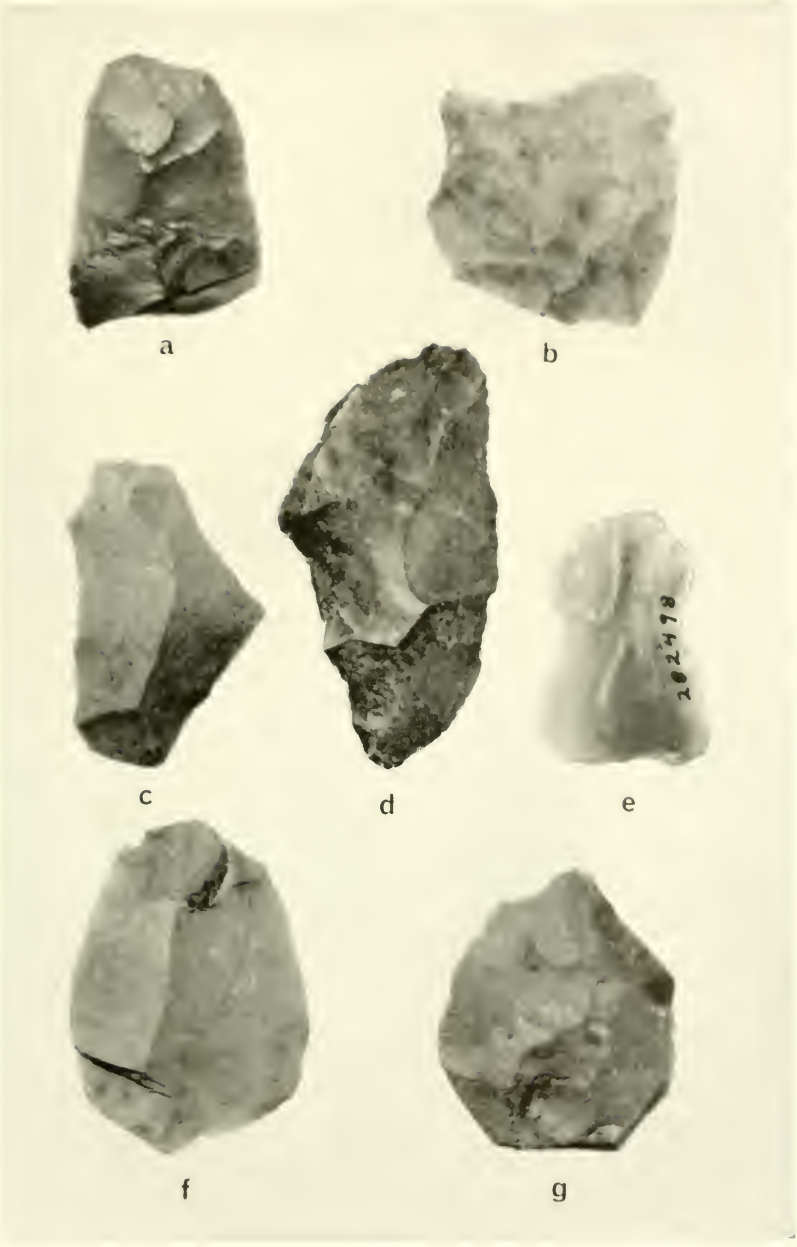

Fig. 61. Flake knives made from prepared cores. Length of *e* is 4.02 cm.

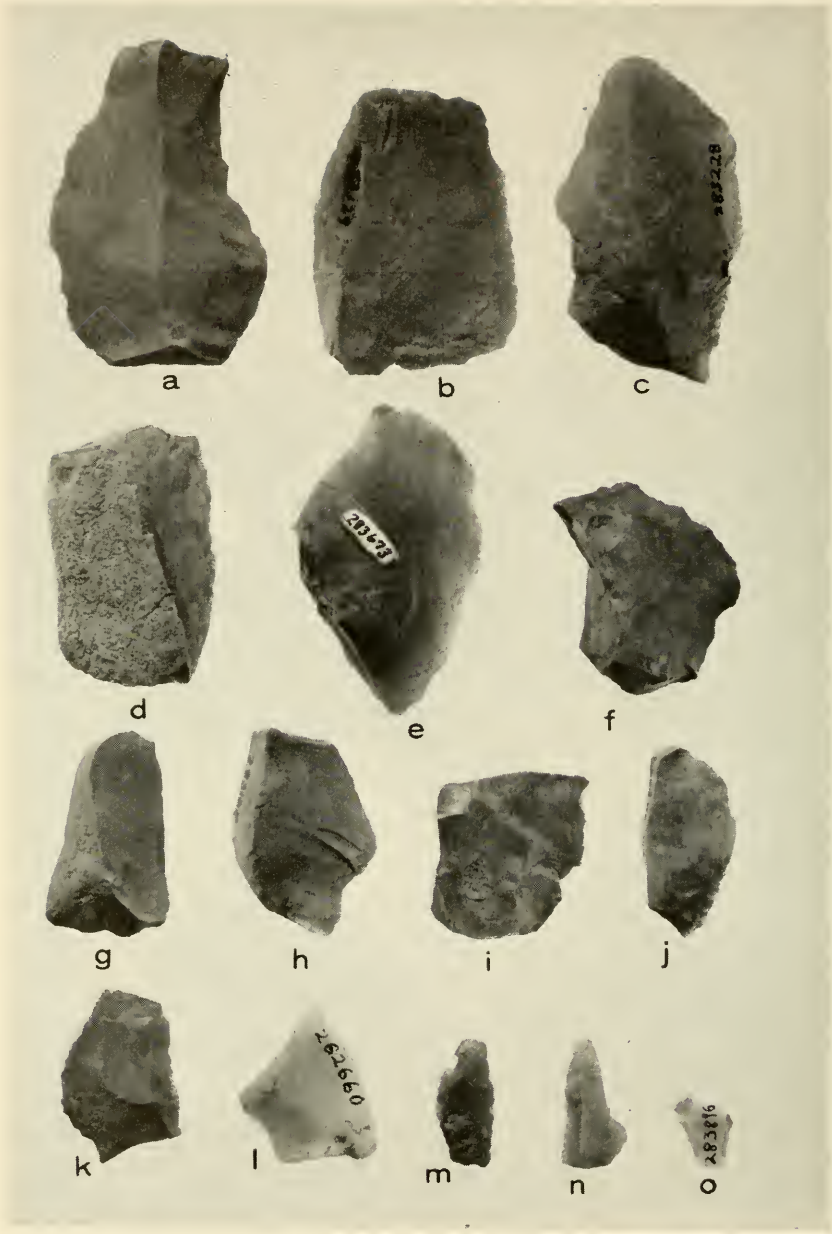

Fig. 62. Flake knives. Length of *o* is 1.6 cm.

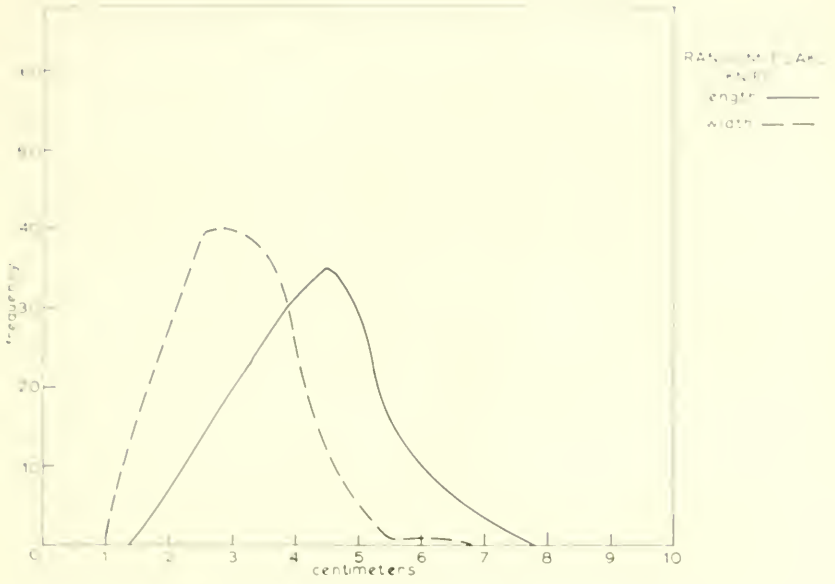

Fig. 63. Distribution of dimensions of random-flake knives.

Woodbury, 1954, pp. 121–123). In nearly every other part of the world, the term *blade* is reserved for a specific type of thin flake with parallel sides and a width to length ratio below 0.35 or .40. Blades are the result of a particular flaking technique and tools made on blades are quite distinctive. I feel that the term *blade* should be used only for such specialized flakes (cf. White, Binford, and Papworth, 1963, pp. 18–23).

Blades are present in many Southwestern assemblages, but, because they are not segregated as a flake type, we do not know how important they were in the prehistoric tool kit. Blades and near-blades or lamellar flakes (White, Binford, and Papworth, 1963, pp. 15–18) are present in the assemblage at the Broken K Site. They were almost all utilized in unmodified form. A total of 21 unmodified but utilized blades was found (Fig. 64). Two examples were recovered with steep retouch along one edge and were classified as backed blades. All the blades and lamellar flakes from the Broken K Site showed irregular utilization flaking along one or both edges. Mean length of these items is 4.4 cm.; mean width is 2.3 cm.

Knives.—These are bifacially-shaped and trimmed artifacts generally having a lanceolate shape. They differ from flake knives in that the basic shape of the flake has been altered (see pp. 85–86, above). These are the items that have often been termed *blades* by various Southwest prehis-

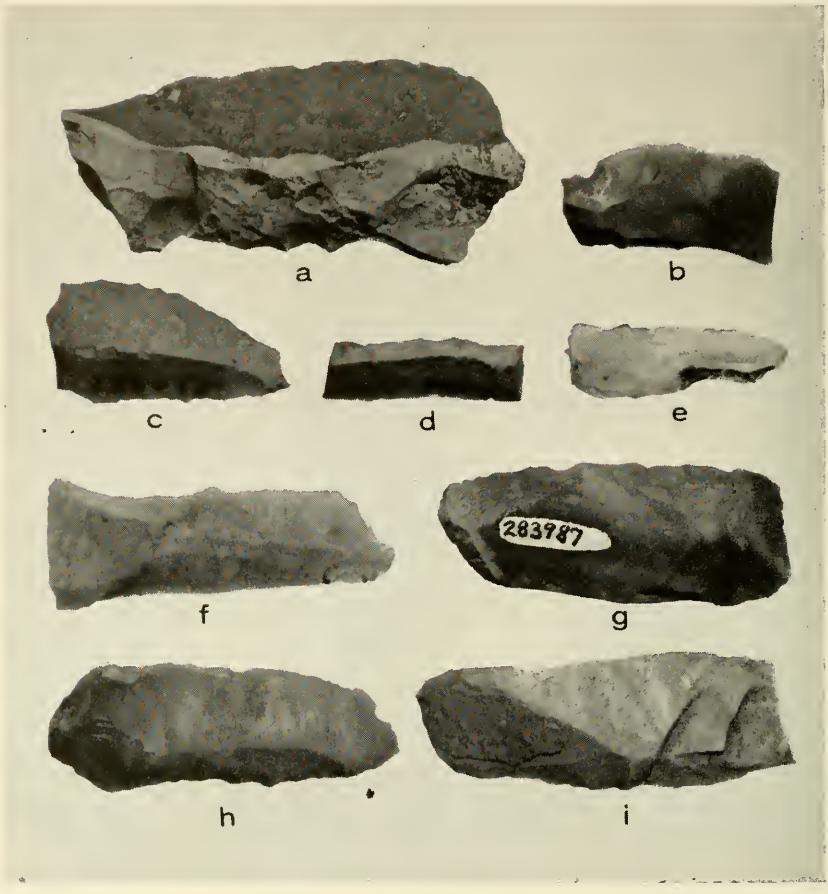

Fig. 64. Blades (*a*, *b*, *e–i*) and backed blades (*c–d*) Length of *d* is 3.0 cm.

torians (cf. Martin *et al.*, 1964b, p. 84). This terminology is not employed in this report for reasons discussed above (p. 86).

These items were probably hafted as cutting implements. The acute bifacial retouch would suggest a cutting function. The majority of these tools have flat or rounded bases with no modification for hafting apparent. Twenty-two were recovered (Fig. 57, *b–f*, and *h*).

Two examples were found with basal modification to facilitate hafting (Fig. 57, *a* and *g*).

Scrapers.—I use this term to describe a class of tools with a working edge produced with steep retouch techniques. The angle of the working edge is thus steep and not acute. Types within this class are determined

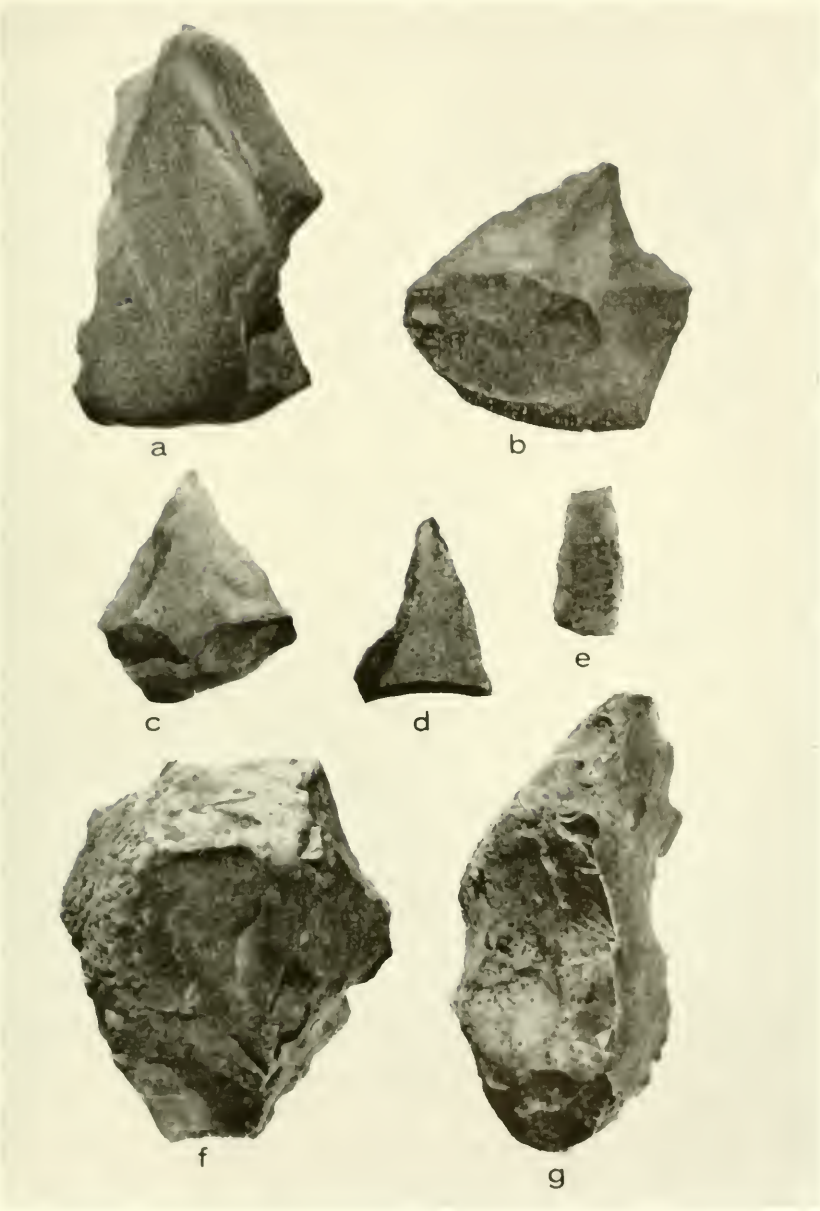

Fig. 65. Side scrapers. Those made on flakes (*e*–*g*), on a core (*b*), and on a cobble (*a*). Length of *e* is 2.1 cm.

by the location of the retouch. The shape of the flake or cobble on which these tools were produced is essentially unaltered.

Side Scrapers.—The steep retouch appears along one or both sides measured in terms of the axis of percussion of a flake or the longest dimension of a core or cobble.

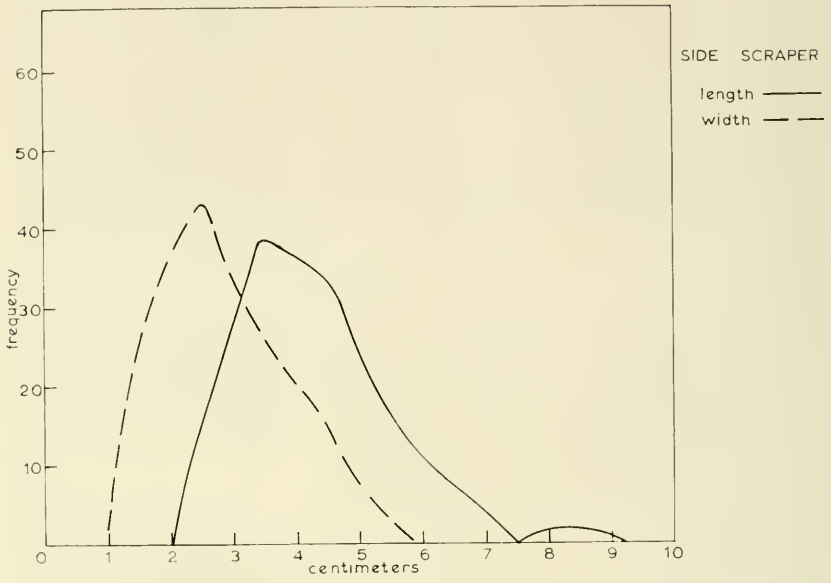

Fig. 66. Distribution of dimensions of side scrapers.

Ten side scrapers were found that were produced on exhausted core nuclei (Fig. 65, *b*) and six that were made on small cobbles (Fig. 65, *a*). By far the majority of these tools were produced on flakes. A total of 112 side scrapers on flakes was excavated (Fig. 65, *c–g*). The distribution of the flake sizes selected for modification into side scrapers is presented in Figure 66.

Two specialized examples of side scrapers were recovered. Both of these were made on fairly small contracting flakes. There is a broad, shallow notch worked into one side with further modification in the form of steep retouch (Fig. 58, *e* and *f*). These items have a series of attributes that suggest their use as a spokeshave or similar tool.

End Scrapers.—The steep retouch appears at one or both ends of the tool, measured in terms of the axis of percussion of the flakes and, for those made on core nuclei or small cobbles, the longest dimension. Exactly 50 end scrapers were recovered during the excavations at Broken K Pueblo, and all but seven of them were produced on flakes (Fig. 67).

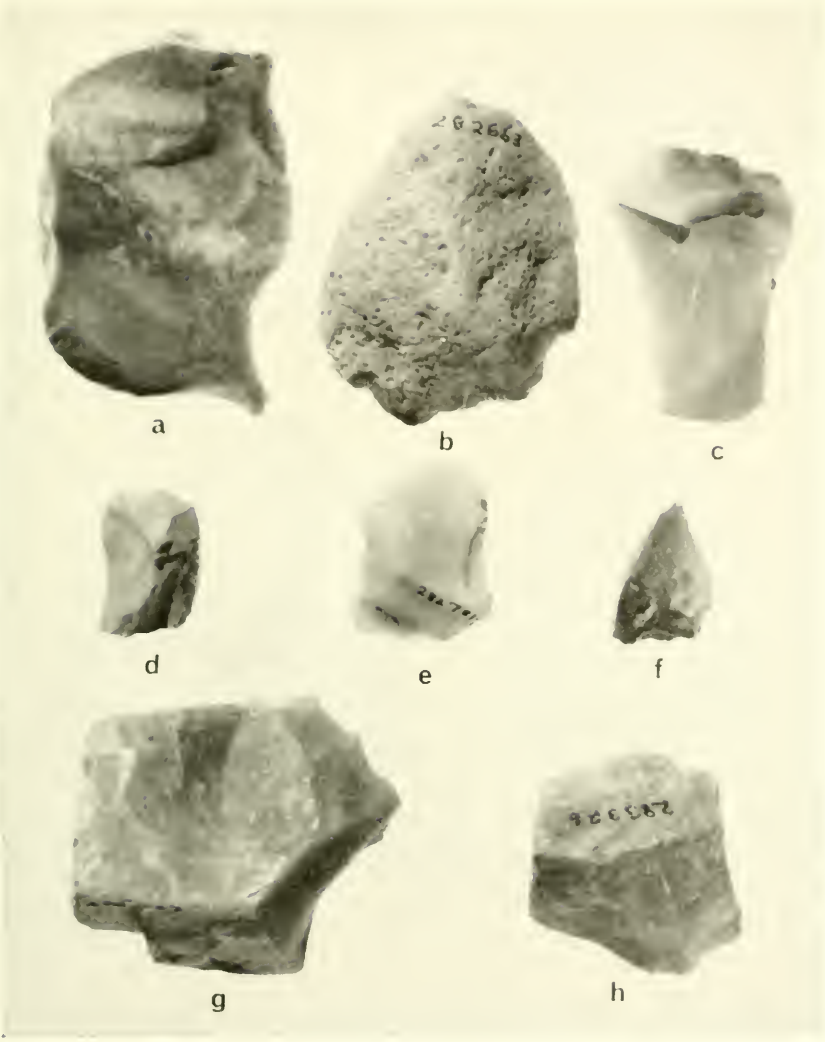

Fig. 67. End scrapers. Those made on flakes (*a f*), on a core (*g*), and on a cobble (*h*). Length of *h* is 4.0 cm.

Only three end scrapers were found that had been made on exhausted core nuclei. All three were cores of the split cobble type, and all three had steep secondary retouch at one end (Fig. 67, *g*).

Four were produced on small river pebbles. These tended to be thin and of a generally rectangular shape. Steep secondary retouch was present at the end of the tool measured as the longest dimension (Fig. 57, *h*).

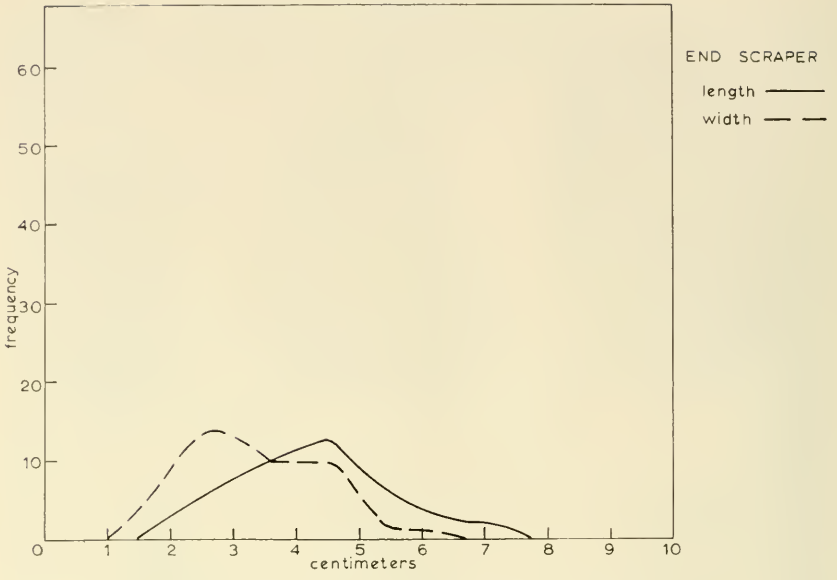

Fig. 68. Distribution of dimensions of end-scrapers.

A total of 43 end scrapers made on flakes was found at the site. The steep retouch appears at one or both ends, and the shape of the flake is unaltered. The flake shapes selected by the knappers for end scrapers are presented graphically in Figure 68. The mean size of these tools is about 4 cm. long and 3 cm. wide.

Ovate Scrapers.—These implements exhibit steep retouch on two or more edges. The prepared edge is not limited to an end or side. The outline of these tools tends to be oval or square (Figs. 69 and 70). Most of the ovate scrapers were made on flakes; there were 123 of these out of a total of 163 ovate scrapers. Only 24 were produced on a core nucleus and all of these were made on cores of the split cobble type. Nine ovate scrapers were produced on small stream pebbles.

Those made on flakes had a mean size of approximately 4.5 by 3.5 cm. Ovate scrapers made on cores and pebbles tended to be less uniform in size and shape. The basic shape of the flake, pebble, or core was unaltered by the retouch (cf. Fig. 71).

Shapes of Scrapers and Knives.—In order better to understand the knapping technology present at Broken K Pueblo, it was decided to examine the shapes of flakes and tools made on flakes and, in some cases, small stream pebbles. We wished to know if certain shapes that were available were being selected for particular kinds of tools.

Fig. 69. Ovate scrapers. Those made on cores (*a* and *b*), and on cobbles (*c* and *d*). Length of *d* is 4.8 cm.

Ideally, it would have been best to compare the various tool types produced on flakes where the outline of the flake was essentially unaltered with the unused lithic debris. But we did not have any measurements on the thousands of examples of flakes that were the products of knapping. In essence, we had only those flakes that had been selected for use, either in unaltered form as "utilized flakes" or slightly modified with retouch as various types of scrapers or flake knives.

We decided to compare a number of types of such items among themselves to see if there were significant differences in shape. Utilized flakes were held as the "control" in the assumption that they would probably be closest to the total range and variation in proper relative frequencies

to the actual range of shapes available to the tool maker in the total population of flakes possible with the knapping technology.

The results of these investigations do suggest a selection of flake shapes for particular types of tools; but also suggest that "utilized flakes" may have been selected with certain sizes in mind for certain tasks and, therefore, might have "skewed" our control. In addition, the factor of thickness

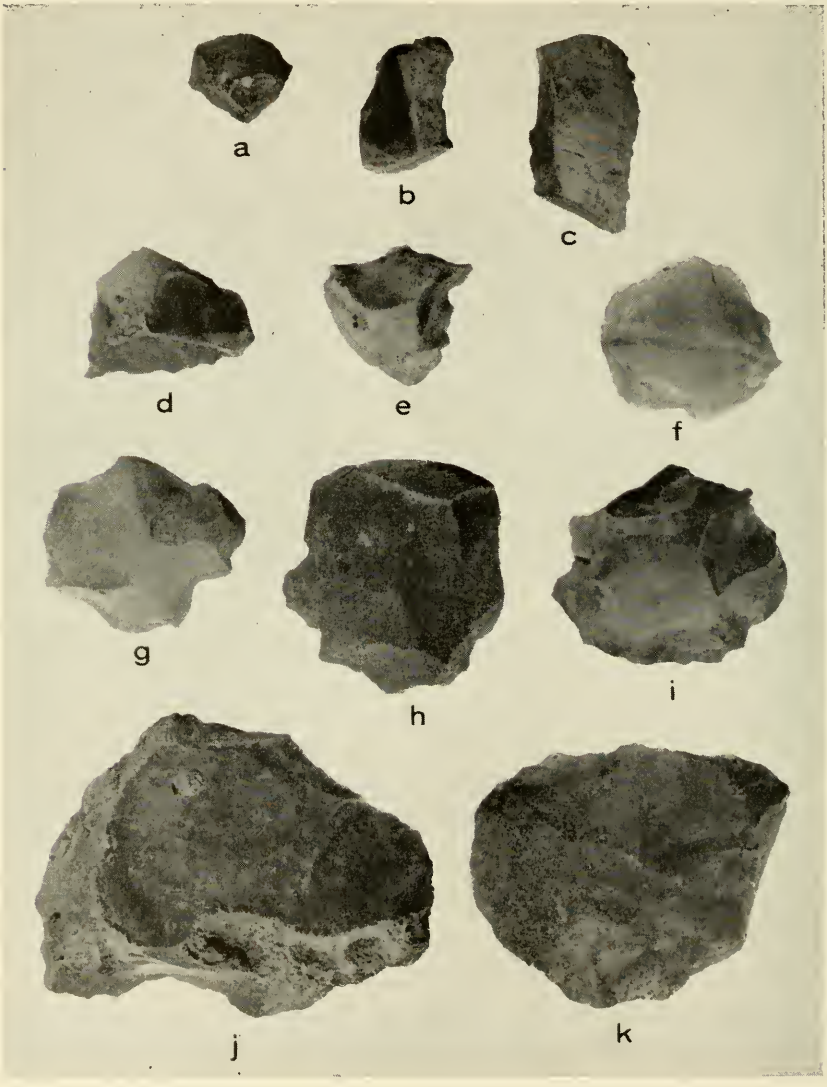

Fig. 70. Ovate scrapers made on flakes. Length of *k* is 8.4 cm.

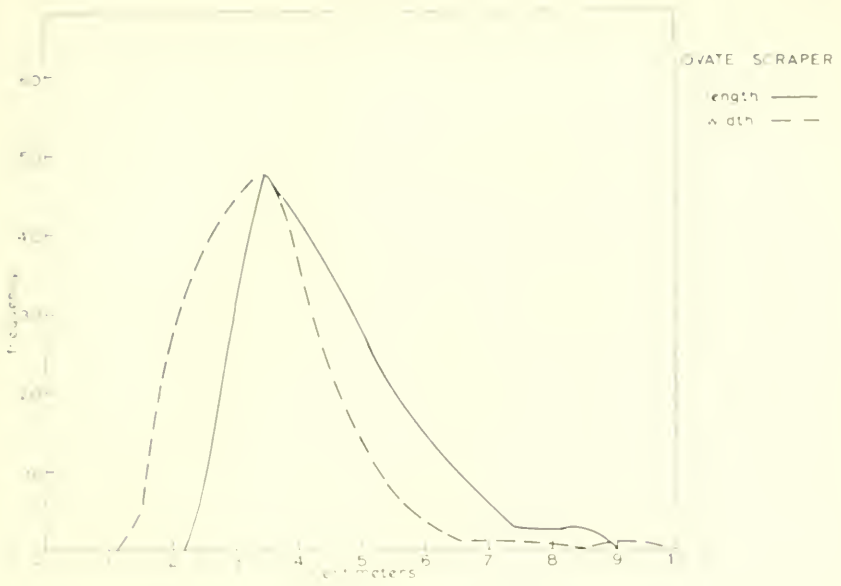

Fig. 71. Distribution of dimensions of ovate scrapers.

of flake is probably important, but this dimension was not considered in our original experiment. Future tests should control the shape and thickness variation of the total sample of both tools and lithic waste debris.

Five types of tools were utilized in this experiment: utilized flakes, side scrapers, end scrapers, flake knives, and ovate scrapers. Graphs portraying the shape and frequency of each type are presented in Figures 60, 63, 66, 68, and 71. Table 1 presents the results of the statistical tests of significance for the variations in shapes of these tool types as well as summary figures of the range and variation in length and width for each type.

Both the F and t tests for statistical significance were employed (Moroney, 1956, p. 227f and 233f). The t test was found to be more sensitive in this particular experiment. The results (Table 1) indicate several generalizations. The flakes selected for ovate scrapers were significantly different in size and shape from the flakes utilized for other tools. This particular size and shape was in the mind of the knapper before retouching the working edge. Also, the width of the flakes selected for end scrapers was a significant factor. Thus, the width of the working edge was a critical aspect in the selection or production of flakes for end scrapers. This suggests that the specific tasks for which end scrapers were used were quite specialized and these tasks were clearly in the mind of the knapper in fashioning these tools.

Table 1.—SHAPES AND SIGNIFICANCE OF VARIATION IN FIVE TOOL TYPES FROM BROKEN K PUEBLO

		LENGTH			WIDTH		
Type	Sample Size	Mean	Median	S.D.	Mean	Median	S.D.
Utilized Flake	226	4.02	3.80	1.59	2.98	2.82	1.09
Side Scraper	112	4.22	4.06	1.50	2.87	2.73	1.10
Flake Knife	106	4.24	4 23	1 52	2.99	2.90	0 92
Ovate Scraper	128	4.44	4.18	1.75	3.56	3.56	1.37
End Scraper	41	4.33	4.27	1.94	3.28	3.15	1.38

F test summary:

	Utilized flake		Side Scraper		Flake Knife		Ovate Scraper	
	Length	Width	Length	Width	Length	Width	Length	Width
Side Scraper	NS[1]	NS						
Flake Knife	NS	NS	NS	NS				
Ovate Scraper	NS	NS	NS	NS	NS	.05		
End Scraper	NS	NS	NS	NS	NS	.05	NS	NS

t test summary:

	Utilized Flake		Side Scraper		Flake Knife		Ovate Scraper	
	Length	Width	Length	Width	Length	Width	Length	Width
Side Scraper	NS	NS						
Flake Knife	NS	NS	NS	NS				
Ovate Scraper	.01	.01	NS	.01	NS	.01		
End Scraper	NS	.10	NS	.05	NS	NS	NS	NS

[1] NS — Not Significant

The shapes and sizes of the other tools tended to be more homogeneous. Significant variation among these types would probably be demonstrable if the variable of thickness had been utilized and if these types were compared to the thousands of flakes which had *not* been selected for modification into tools.

Choppers.—These are large, bifacially worked chopping-cutting tools. In all cases the sharpened edges show battering and irregular chipping resulting from use. In many cases, the unworked surfaces show battering as well, perhaps indicating their use as hammerstones. In summary, the 180 tools classified as choppers appear to be multi-functional implements utilized in cutting and chopping operations as well as for tasks requiring hammering.

The class labeled *choppers* was segregated into three types based on the form of the stone selected for modification. Since almost all of these items were assigned field numbers and were not brought to the Field Museum of Natural History for further analysis, I have had to rely on the cards prepared for each artifact by Miss Rose for the typology.

The first type consists of water-worn stream pebbles with one end or side trimmed bifacially with percussion flaking. A total of 58 choppers of this type was recovered from the excavations (Fig. 47, *e*).

A second type consisted of exhausted or workable cores with one edge retouched bifacially. All 95 examples of this type showed use chipping and battering on the chopping edge.

A third type of chopper was recovered from the pueblo. These choppers were formed on large, thick flakes with bifacial trimming forming the working edge. All 37 examples of this type exhibited use chipping and battering.

Cores.—A total of 59 cores was found at the Broken K Pueblo. All but five of these were split cobble cores. A stream pebble, usually of chert, was selected and split in two. The weathered surface was then removed using the flat split surface as a striking platform. Then flakes were struck from all surfaces of the prepared core often employing prepared striking platforms until the core was either exhausted and the nucleous discarded or fashioned into a tool, or in some cases the workable core was discarded before it became exhausted. Split cobble cores are illustrated in Figure 72 in various stages of use.

Nothing can be said regarding cores in the prehistoric Southwest because they generally are not studied. If cores are recognized, they are usually simply noted as present with no attempt at description or analysis (e.g., Woodbury, 1954, pp. 134–135).

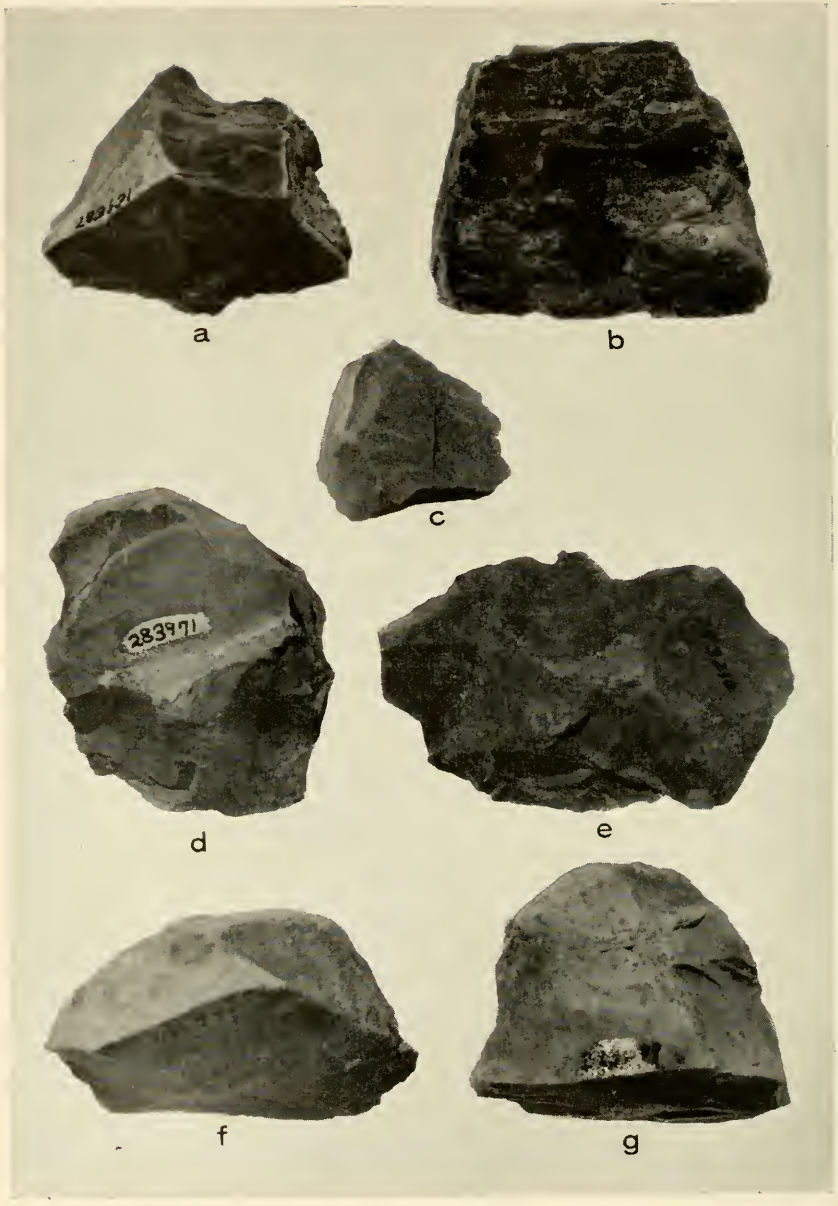

Fig. 72. Cores. Split cobble type (*a*, *d–g*); exhausted nucleous (*c*); and block core (*b*). Length of *g* is 5.6 cm.

Only five examples of a second type of core were recovered. These are block cores which are rectangular blocks of stone from which lamellar flakes or blades were removed using one or two striking platforms (Fig. 47, *b*). One example of a block core was found with a bifacially trimmed cutting edge worked into one side (Fig. 47, *b*).

Miscellaneous Stone Artifacts.—A total of 72 stone artifacts was recovered which do not fall within neat functional classes. For some of these items, a "ceremonial" use has been suggested by various prehistorians, but for many of these specimens, there is no clear indication as to function.

Nine large, thin slabs of sandstone which had been roughed into circular shape were found. They ranged in size from 11 to 27 cm. in diameter. Six smaller discs were recovered which were also made of sandstone, ranging in size from 5 to 8 cm. in diameter (Fig. 73, *b*). Quite similar items were recovered at the Carter Ranch Site where they also occurred in two size modes (Martin *et al.*, 1964b, pp. 78–81; fig. 34). Rinaldo (*Ibid.*, fig. 34) calls them "pot covers", but lists other inferred uses including covers for storage pits. He (*Ibid.*, pp. 78–81) presents details of the distribution of these items in the Southwest.

Three small, irregular slabs of sandstone were found, each with a hole drilled through the center (Fig. 73, *c*). Their use is unknown. A single example of a thin piece of sandstone that had been roughly shaped into a lanceolate outline was recovered. Its edges were unsmoothed and its function is undetermined.

Three fragments of large, rectangular "tablets" of stone were found at the site. The edges were smoothed and squared and both top and bottom surfaces were well-smoothed. Their reconstructed sizes are approximately 10 by 12–15 cm. Their use is not determined.

Three "medicine cylinders" of vesicular basalt were recovered (Fig. 52, *d*). One example of a similar shape and form produced in fine-grained sandstone was found.

Two stone tools occurred that may have functioned in weaving operations. One was an elongated piece of fine-grained sandstone with a deep groove worked all the way around the item, lengthwise (Fig. 52, *c*). The other was a "stone needle", a thin, lanceolate-shaped piece of smoothed stone with one end pointed and the other end blunted. A hole was drilled through the blunted end. (Fig. 52, *e*).

One large sandstone disc was found with a hole drilled near its edge. Both surfaces of the disc were smoothed and the edges were smoothed and rounded. Its use is unknown.

Naturally occurring, unusually shaped stones were found at the site. These included a fragment of a circular stone concretion and two ex-

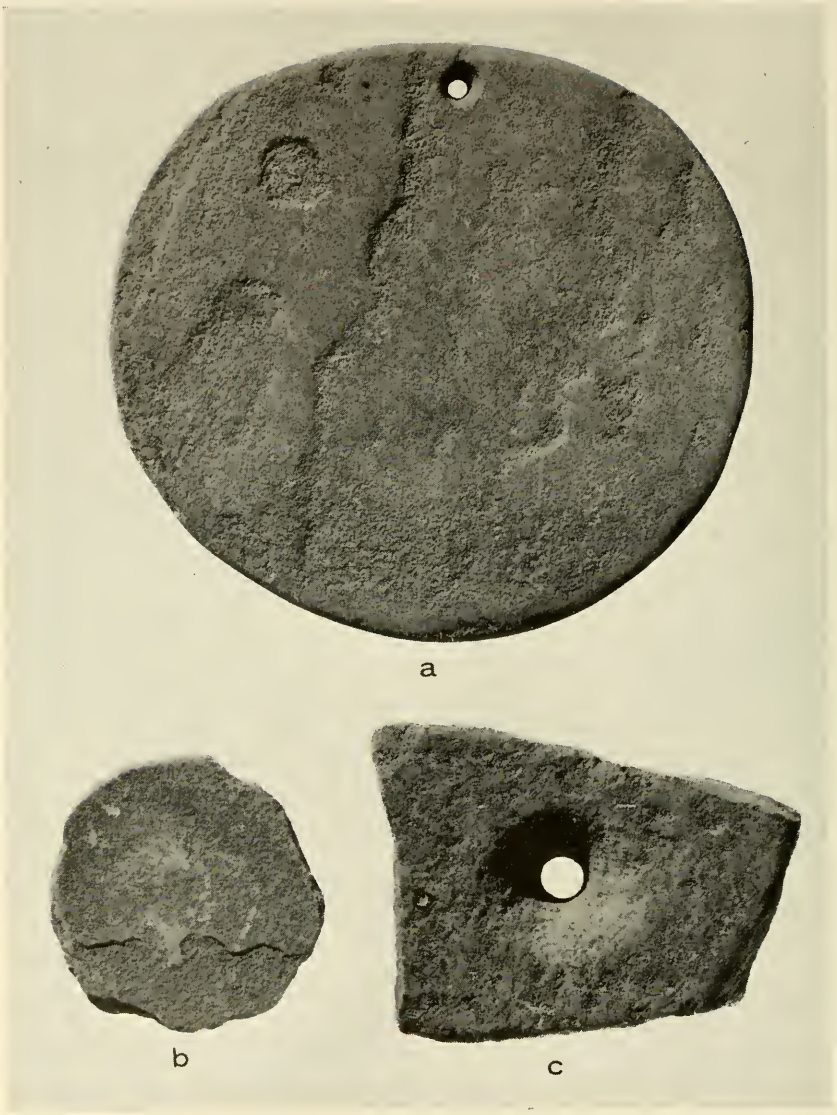

Fig. 73. Miscellaneous stone artifacts. Large sandstone disc with edges smoothed and hole near edge, *a;* circular sandstone slab, *b*. Diameter of *a* is 15.7 cm.

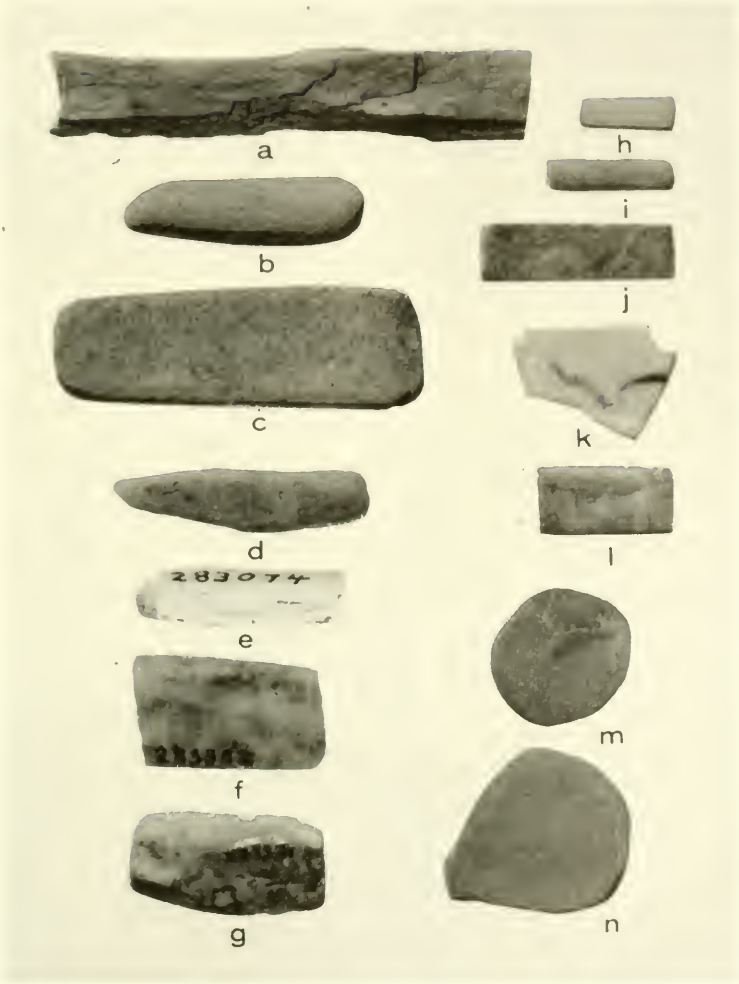

Fig. 74. Miscellaneous stone, bone, and shell artifacts. Petrified wood "tinkler", *a*, water-worn stone, shaped, *b;* stone "tablet", *c;* water-rolled stone, polished, *d;* quartz crystal, *e;* stone tablet, incised lines on surface, *f;* irregular piece of stone, edges squared and polished, *g;* small polished stone tablets, *h–j;* irregular piece of shell, edges squared, *k;* polished portion of bird long-bone, *l;* "medicine disc," *m;* irregular flat stone, edges squared, *n*. Length of *n* is 2.9 cm.

amples of quartz crystals (Fig. 74, *e*). These items probably functioned in a ceremonial context, but their exact use is not known.

A number of small, shaped, and polished stone items were recovered during the excavations. Their exact use is undetermined, but they probably were utilized in ceremonial or gaming activities. Six small rectangular "tablets" made of sandstone with edges that were smoothed and squared were found. The flat surfaces were unaltered. They were all about 0.5 cm. thick and ranged in length from 4 to 5 cm. and in width from 2 to 3 cm. (Fig. 74, *b*). A similar item was found made of a hard, dark colored stone which was polished on all surfaces with two incised lines on one face (Fig. 74, *f*). In addition, six examples of a much smaller rectangular stone "tablet" were found. These were narrow rectangular pieces of fine-grained stone with smoothed and squared edges and all surfaces polished. They ranged in length from 1.5 to 3.6 cm., in width from 0.5 to 1.0 cm., and in thickness from 0.2 to 0.5 cm. (Fig. 74, *h*). Four examples of small, water-rolled stones which had been smoothed and polished were found. There was some purposeful shaping evident (Fig. 74, *d*).

Four examples of small stone discs were found. These were thin, circular pieces of stone with polished surfaces and squared and smoothed edges. Diameters ranged from 2 to 4 cm. (Fig. 74, *m*). Their use is not known.

A total of 17 small, irregular pieces of thin, flat stone was found. The edges of these pieces had been squared and smoothed and their surfaces had been polished (Fig. 74, *n*).

Two examples of stone "tinklers" were recovered at the site. These were both fashioned from splinters of petrified wood and were notched at one end (Fig. 74, *a*).

Similar miscellaneous stone artifacts were found at the Carter Ranch Site. Rinaldo presents excellent descriptive notes and details of their distribution in the Southwest (Martin *et al.*, 1964b, pp. 78–81; 96–97)

BONE, ANTLER, AND SHELL ARTIFACTS

Bone Awls.—A total of 89 bone awls was recovered from the Broken K Pueblo. These tools have been segregated into a series of types on the basis of the particular bone selected for the implement and the nature of the alteration. Bone awls were considerably more abundant at the Carter Ranch Site where 120 were found (Martin *et al.*, 1964b, p. 97).

There were ten bone awls produced on ulnae (Fig. 75). Six of these were made on larger ulnae from such animals as deer and antelope

Fig. 75. Bone awls, ulna type. Length of *e* is 4.9 cm.

Fig. 76. Bone awls. Split long bones and cannon bones, condyles intact. Length of *d* is 9.6 cm.

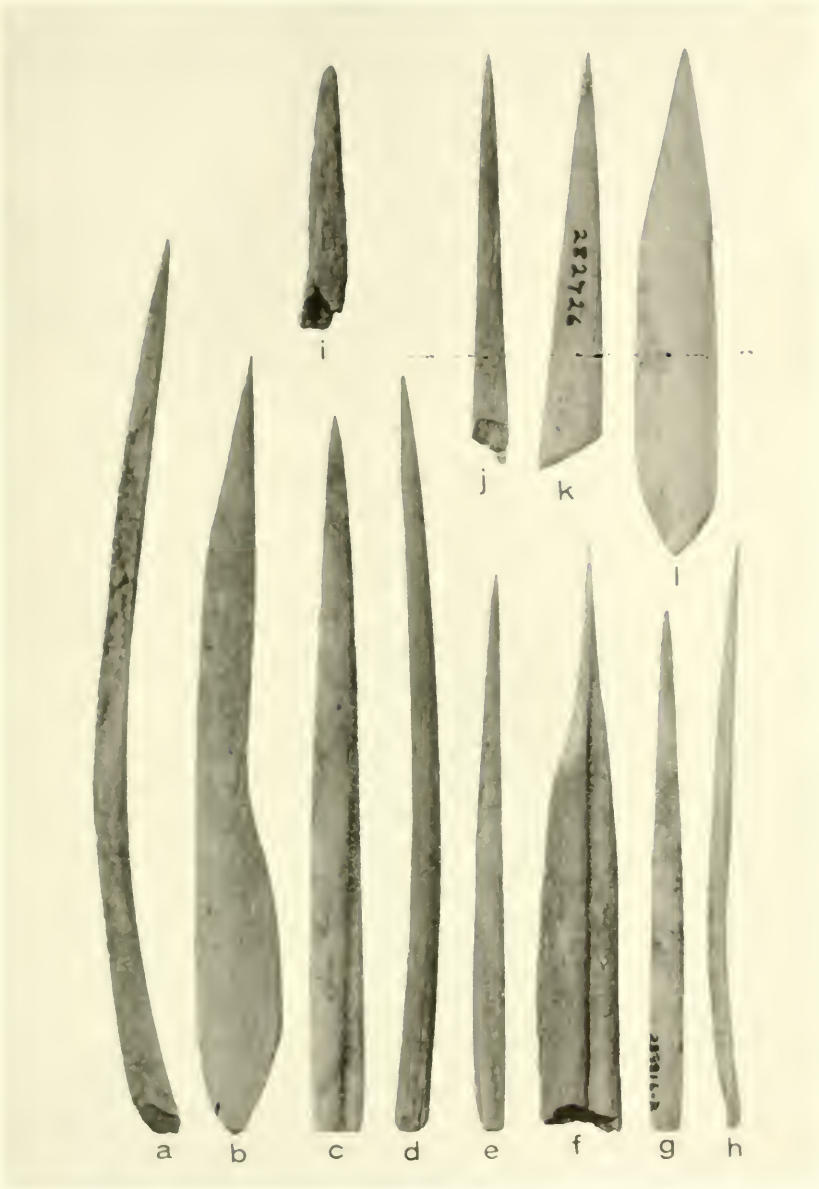

Fig. 77. Bone awls made from splinters. Length of *g* is 8.9 cm.

(Fig. 75, *c* and *d*), and one was found which was quite small (Fig. 75, *e*). Three were recovered which either had the condyle removed or nearly so (Fig. 75, *a* and *b*).

There were six awls found of the split long bone type with the condyles unaltered (Fig. 76, *a*, *b*, *d*, and *e*). One split long bone awl had its condyle abraded (Fig. 76, *c*).

The most abundant type consisted of bone splinter that had been sharpened. There was a great range in size of the 68 awls of this type (Fig. 77, *a–h*, *j–l*).

One awl was found that had been produced on the tip of an antler tine (Fig. 77, *i*), and three awl fragments that were too small to place into a category with any certainty were recovered.

Bone Needles.—Four bone splinters were found that had one end squared with a hole drilled through and the other sharpened to a point. Two were fairly large with lengths of from 15–17 cm. (Fig. 78, *b* and *d*), and two were relatively smaller with a length of about 8.5 cm. (Fig. 78, *e* and *f*). One bone needle is reported from the Carter Ranch Site (Martin *et al.*, 1964b, p. 99).

Weaving Tools (?).—Seven bone tools were found made on splinters or split long and "cannon" bones that may have functioned in weaving. The points of all these implements were purposefully blunted and there were no perforations present (Fig. 78, *a* and *c*).

Miscellaneous Bone Artifacts.—A total of 14 bone items was found that did not fall into a system of typology. This category included such items as splinters of bone that had been smoothed, partially split long bones, fragments of deer ribs that had been polished, and pieces of split long bone shafts that had been polished and carved (Fig. 74, *l*).

There were many fewer bone tools found at Broken K Pueblo than occurred at the Carter Ranch Site. Perhaps of significance is the lack of the Grooved Bone Awl type at the Broken K Site, a type that was found in some abundance at Carter Ranch Pueblo (Martin *et al.*, 1964b, p. 99).

Miscellaneous Shell Artifacts.—Five small, irregular fragments of shell were found, all of which had squared and smoothed edges (Fig. 74, *k*). Their use is not known.

Antler Flakers.—A total of 14 antler-tine flaking tools was recovered. All of these implements had beveled or rounded ends and all exhibited evidence of battering (Fig. 79, *c* and *e*).

Antler Wrench.—These items are basal fragments of large antler shafts which have been split and one, two, or more holes drilled through. The holes in these tools are approximately 1 cm. in diameter. Three antler wrenches were found at Broken K Pueblo (Fig. 79, *a*, *b*, and *d*).

Fig. 78. Miscellaneous bone artifacts. Blunted tools, *a* and *c*; needles, [illegible]. Length of *c* is 18.2 cm.

Fig. 79. Antler flakers (*c* and *e*) and antler wrenches (*a*, *b*, *d*). Length of *c* is 15.5 cm.

CEREMONIAL ITEMS, ORNAMENTS, PIGMENTS AND MINERALS

A total of about 500 items of this general category was found at Broken K pueblo. They have been segregated into classes and, in some cases, into types.

Pendants.—The 22 ornaments of this class have been classified on the basis of material of manufacture: bone, shell, stone, or pottery.

Three pendants made from bone were recovered: one was a section of the shaft of a long bone with both ends beveled and smoothed, and a deep incision made all around one end of the shaft (Fig. 80, *a*); one consisted of a thin, small spall of bone which had been shaped into an oval or "teardrop" shape with a small hole placed in the smaller end (Fig. 80, *c*); and the other bone pendant was a flat piece of bone which was carved into symmetrical shape. The last has a rectangular center section with a single rounded projection on either side and a small hole drilled in the top of the central portion (Fig. 80, *b*).

Twelve pendants made from shell were found. Of these, one was of a "teardrop" shape with a hole drilled in the smaller end (Fig. 80, *d*). One consisted of a small bivalve shell (probably *Glycymeris maculata*) with a hole drilled at the "hinge" (Fig. 81, *h*). Five pendants made from conical shells were found. Most of these appear to have been made from *Conus* (*Chelyconus*) *ximenes*, but at least one was produced on *Turritella gonostoma*. These pendants exhibited little modification beyond a single perforation or notch and smoothed edges (Fig. 81, *e*, *f*, and *i*). One was produced on a triangular section from a large, unidentifiable shell. The edges are squared and smoothed and a hole appears at the apex. A zoomorphic figure has been carved or etched on the convex surface (Fig. 80, *c*). Four fragments of shell pendants were found.

A single example of a stone pendant occurred. It was fragmentary, but appears to be a thin piece of stone having irregular outlines with smoothed edges and a hole drilled at one edge.

Six ceramic pendants were found at the site. Four of these were circular in outline, with squared and smoothed edges and with a single hole drilled near the edge (Fig. 80, *g*). Two of these were Show Low Black-on-red, one was an indeterminate black-on-white, and one was a brown ware with a polished smudged interior. Two examples were sub-triangular in shape with squared and smoothed edges and a hole placed at the smaller end. One was Snowflake Black-on-white, Hay Hollow Variety (Fig. 80, *h*), and the other was made on a plain, brownware sherd with a smudged interior. A geometric design has been incised on the exterior surface (Fig. 80, *f*).

Fig. 80. Pendants. Bone pendants, *a*, *b*, *e;* shell pendant, *d;* carved and etched shell pendant, *c;* incised sherd pendant (Plain Brown Ware, smudged interior), *f;* sherd pendant (Show Low Black-on-red), *g;* sherd pendant (Snowflake Black-on-white, Hay Hollow Variety), *h*. Length of *h* is 3.8 cm.

Beads.—Approximately 400 beads of various kinds were recovered. These included about 30 beads of whole *Olivilla* sheels. But the majority of the beads were of the small disc type of either shell or stone. Approximately half of the beads found at the site were in association with burial number one from room 27. The remainder were recovered from trash, floors, and pits.

Shell Bracelets.—Four examples of bracelets were found. All were fragments and all were produced on *Glycymeris* shell. One example had a

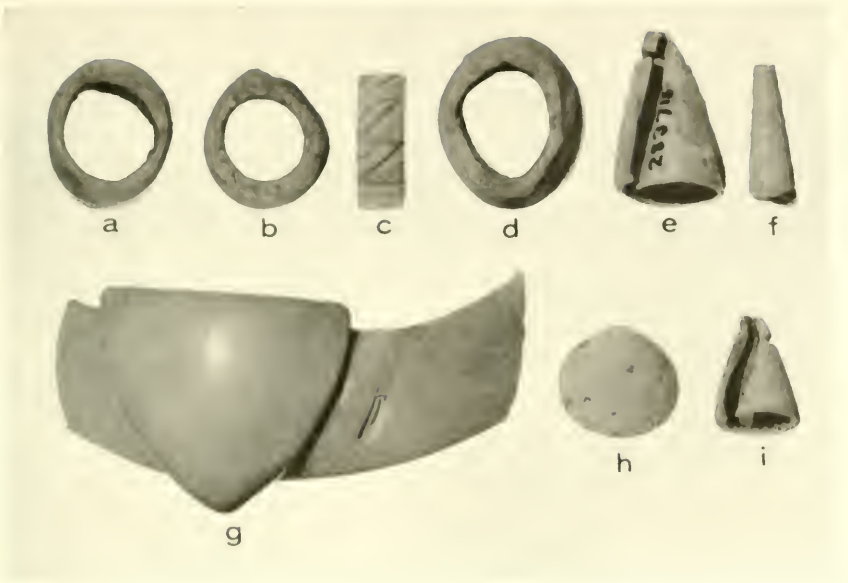

Fig. 81. Ornaments of bone and shell. Bone rings, *a–d;* shell pendants, *e, f, h, i;* shell bracelet fragment, *g*. Length of *e* is 2.3 cm.

Fig. 82. Pigment (red hematite) *b, c,* and irregular lumps of turquoise, *a* and *d*.

Fig. 83. Bone ring material. Length of *a* is 4.5 cm.

raised portion at the top of the bracelet in a triangular form, and an incised geometric design on the body (Fig. 81, *g*).

Pigments.—Nine examples of pigment lumps were found. Seven of these were irregular hunks of red hematite with one or more worn and smoothed facets (Fig. 82, *b* and *c*). One example each of azurite and yellow limonite were excavated.

Turquoise.—Four irregular lumps of turquoise were recovered. There was some evidence of smoothing on each, but there were no perforations nor any definite shaping (Fig. 82, *a* and *d*). All but one example were found in floor context.

Asbestos.—A single, irregular lump of this mineral was found on the floor of room 60.

Bone Rings.—These items are circular sections cut from long bone shafts with beveled edges and generally smoothed surfaces (Fig. 81, *a–d*). Three whole examples were found and 12 fragments were recovered. One of the latter had an incised geometric design (Fig. 81, *c*). One fragment of a ring made of shell was found. Rinaldo presents a detailed discussion of bone rings and points to their possible use as beads rather than finger rings (Martin *et al.*, 1964b, pp. 93–94).

In addition, 42 examples of long bone fragments from which the bone rings had been cut were found. Often, there were incisions marking uncut rings and the end of the shaft shows a beveled cut. A total of 25 was recovered with the condyles intact and 17 which had the condyles removed and rings removed from one or both ends of the shaft (Fig. 83).

Bone Tinklers.—Eight tinklers were found at the site. They consist of short sections cut from the shafts of long bones near the articulating end. Their shape is roughly that of a truncated cone. All examples were hollowed with ends squared and smoothed. A small hole appears through the flaring end, near the edge (Fig. 84, *a–c*).

Painted Bone Items.—A total of 11 examples of various bones which had been painted was found. It is not known if these items functioned in gaming or in ideological activities such as divining. All but four were found in the fill of kivas. Eight were scapulae of deer and antelope with geometric designs painted in black on both surfaces. The designs tended to be wavy lines, bars, broad lines, and circles (Fig. 85, *b* and *c*). Two fragments of ungulate mandibles with geometric designs painted with red and black paints were recovered. One example of a skull fragment of *Lepus californicus* was found with black paint applied to the skull vault. The design was indeterminate (Fig. 85, *a*).

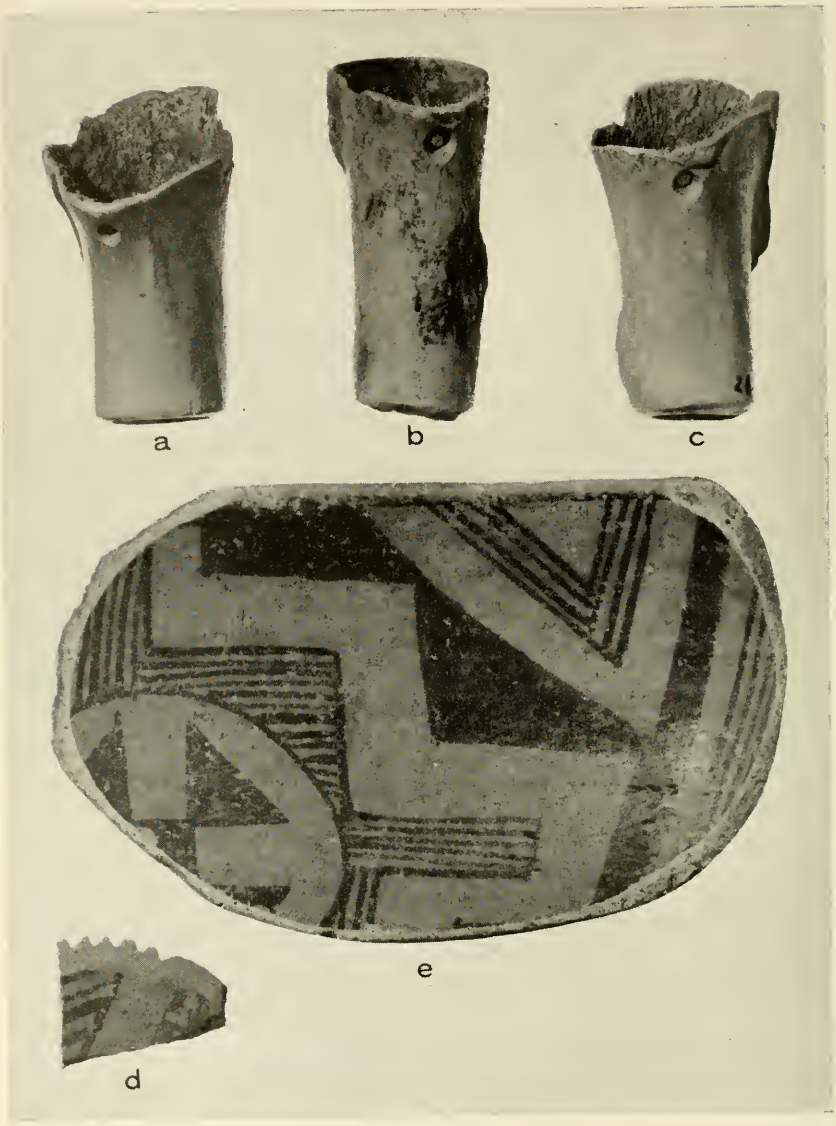

Fig. 84. Bone tinklers, *a–c;* notched sherd (Show Low Black-on-red), *d;* sherd ladle (St. Johns Polychrome) *e*. Length of *e* is 12.0 cm.

Fig. 85. Painted bone. Skull fragment of *Lepus Californicus*, *a*; fragmentary scapulae of *Antilocapra americana*, *b* and *c*.

MINIATURE VESSELS, WORKED SHERDS, AND OTHER CERAMIC ARTIFACTS

A total of five miniature vessels was found at the Broken K Site. The vessel forms were pitchers and jars and one miniature ladle was unearthed. They were quite similar to those found at the Carter Ranch Site (Martin *et al.*, 1964b, p. 104).

Miniature Pitchers.—Two miniature pitchers were recovered. Both of these were Snowflake Black-on-white, Snowflake Variety. In both cases the handles were missing (Fig. 86, *a* and *b*).

Miniature Jars.—Two miniature jars were found. Both examples were brown indented corrugated (Fig. 86, *c*).

Miniature Ladle.—One miniature ladle was recovered. It was a plain brown ware ladle and was in fragmentary condition.

Worked Sherds.—A total of 131 worked sherds was found at the Broken K Pueblo. This class of items was further segregated into four types on the basis of such attributes as the nature of the worked edge and the shape.

Type I: Sherd Blanks. These are sherds roughed into circular or other regular shapes with no evidence of use or smoothing. The edges are rough and appear to have been shaped through spalling. A total of 14 such blanks was found (Fig. 87, *f–j*).

Type II: Sherd Blanks in first stages of use. These sherds exhibit slight and sporadic patterns of wear on the edge. Most of them are circular and appear to be roughed into shape prior to their use. The wear pattern is beveled indicating their use in scraping activities. A total of 25 sherds of this type was found (Fig. 88, *f–h*).

Type III: Pottery Scrapers. These sherds have edges that are well-worn through use. The pattern of wear is beveled indicating a scraping function. A total of 54 such tools was recovered of which 34 were circular in outline and 20 were roughly rectangular (Fig. 88, *a–e*).

Type IV: Pendant Blanks. These are well-shaped sherds, generally with a circular or rectangular outline. The edges of these items are ground to a straight or squared profile. There is no evidence of wear on these sherds; they were not used as scrapers. They are identical to the sherd pendants (above, pp. 111–112) except for the absence of a perforation. A total of 38 sherds of this type was found (Fig. 87, *a–e*).

Not a single example of a pottery disc with a central perforation ("spindle whorl") was found at the Broken K Site. A total of 14 such worked sherds was found at the Carter Ranch Pueblo (Martin *et al.*, 1964b, p. 104).

Fig. 86. Miniature vessels. Pitcher, Snowflake Black-on-white, Snowflake Variety, *a;* pitcher, Snowflake Black-on-White, Snowflake Variety, *b;* Brown Indented Corrugated jar, *c.* Height of *b*, 6 cm.

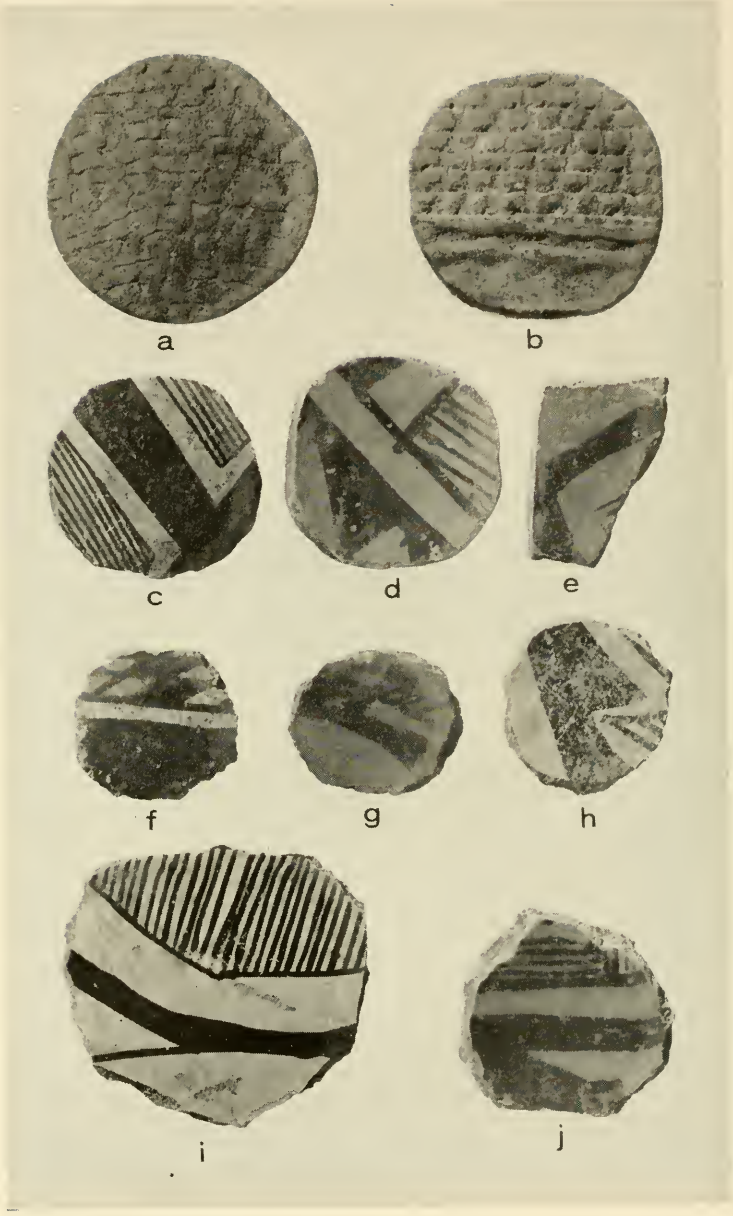

Fig. 87. Worked sherds. Pendant blanks (edges ground to square profile), *a–e;* sherd blanks (roughed into regular shape, no evidence of smoothing), *f–j*. Length of *j* is 4.1 cm.

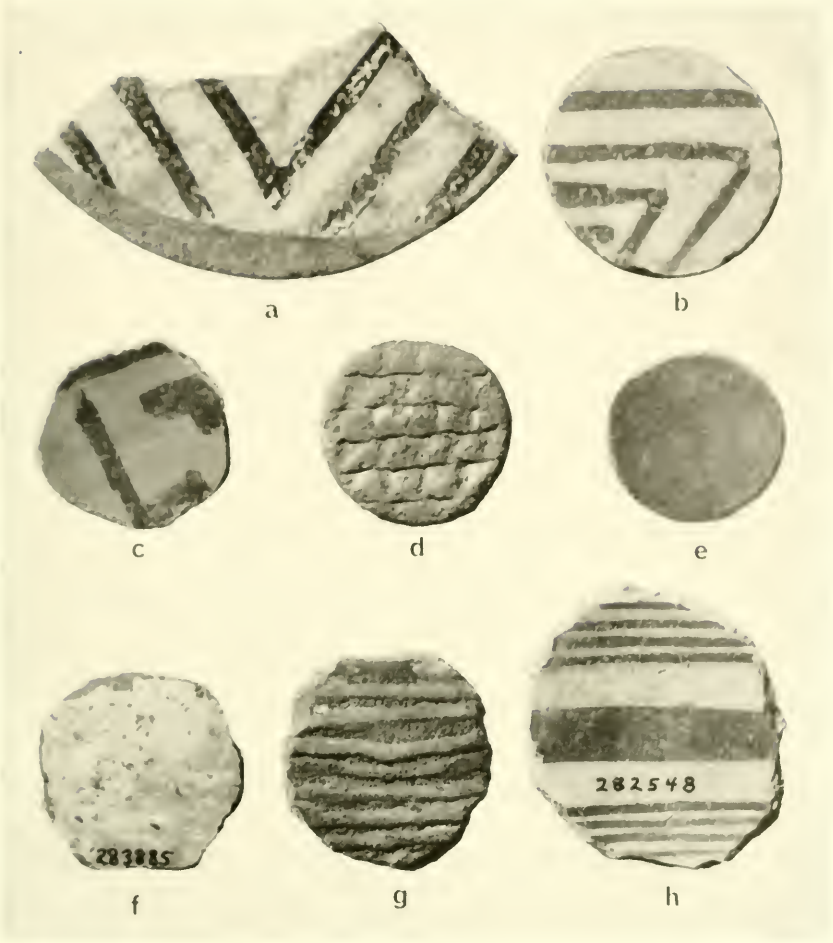

Fig. 88. Sherd scrapers. Scrapers with edges beveled from use, *a–e;* scrapers in first stage of wear, *f–h*. Length of *h* is 5.2 cm.

Sherd Ladles.—Two sherd ladles or scoops were found. One was made from a rim sherd of a large St. Johns Polychrome bowl. The edges of the sherd had been carefully shaped and smoothed (Fig. 84, *e*). The other example was fragmentary; it had been produced on an indeterminate black-on-white sherd.

Miscellaneous Sherd Tool.—One irregular sherd of Show Low Black-on-Red with one edge beveled and smoothed was found. This edge had a series of regular, shallow notches worked into it. Its use is not known; it could be a tool for grooving or stamping clay (no examples of stamped

or grooved ceramics were found), or it might have served in plant processing in some fashion (Fig. 84, *d*). It is similar to two such items recovered at the Carter Ranch Site (Martin *et al.*, 1964b, p. 105).

CORDAGE

Two short fragments of cordage were found in a jar recovered from a pit in the floor of room 33. They are small pieces, but both appear to be Z-twisted cord or string.

LITHIC WASTE

A total of 5868 items of lithic waste was found during the excavations at Broken K Pueblo. These include both flakes and chips as well as "shatter" that were discarded and not utilized in the various stages of preparing stone tools.

In general, lithic waste is not considered an important part of the data from prehistoric sites and as such is often not collected in the field. When it is collected, often it is simply noted as present and then discarded. As far as I can tell, this lack of attention to workshop debris is based on the *a priori* assumption that there is little to be gained from an analysis of such items compared to ceramics and stone tools to augment the picture of an extinct culture. In so far as I know, there has never been a systematic and thorough analysis of such debris from a prehistoric site in the American Southwest.

Binford and Quimby (1963, p. 277) point out that "Since tool production is a process, the techniques and motor habits of which vary stylistically and according to their relative efficiency, it should follow that variations in processes of tool manufacture are as important to our understanding of extinct cultural systems as the variations in the tools themselves." They further suggest (*Ibid.*, p. 278) that isolating the way in which the various steps in tool manufacturing were carried out, by what social groups and at what locations at the site, is extremely important to an understanding of an extinct cultural system.

The nearly 6000 items of lithic waste from Broken K Pueblo were sorted into categories and counted in the field under the direction of Mr. John M. Fritz. His classification and counts form the basis for the analysis reported below. I stress the fact that this analysis is very crude and incomplete. But even at that, the suggestive findings would seem to indicate that further, more sophisticated analyses are in order.

There were no metrical observations available on the debris. The field sorting was in terms of a series of classes of waste such as "core prepara-

TABLE 2.—FREQUENCIES OF LITHIC WASTE, BROKEN K PUEBLO

East Wing

	Fill	Floor
Stage I	338	232
Stage II	1160	682
Stage III	358	312
TOTALS	1856	1226

North Wing

	Fill	Floor
Stage I	73	299
Stage II	151	449
Stage III	59	158
TOTALS	283	906

West Wing

	Fill	Floor
Stage I	152	149
Stage II	429	416
Stage III	109	68
TOTALS	690	633

South Wing

	Fill	Floor
Stage I	10	42
Stage II	22	161
Stage III	3	36
TOTALS	35	239

tion shatter", "core preparation flakes", and these categories were further sub-divided on the basis of fine-grained and coarse-grained raw material. Limitations of time imposed the necessity for lumping certain of these categories. When this was done, a gross, three-fold classification resulted. All lithic debris was segregated into three major classes: core preparation material; primary shaping debris; and secondary shaping debris.

The core preparation material includes both flakes and shatter resulting from the preparation of cores for the production of flakes for tool manufacture. Included in this category are decortication flakes and primary shatter (cf. White, Binford, and Papworth, 1963, p. 3; Binford and Quimby, 1963, pp. 286–288). The primary shaping debris includes both unutilized flake blanks and secondary-flaking rejects (White, Binford and Papworth, 1963, p. 7; Binford and Quimby, 1963, pp. 296–299). Secondary shaping debris includes chips and small flakes resulting from both primary and secondary retouching of flake blanks. These three categories

represent three major stages in the manufacture of stone implements. The first step is the preparation of the core; the second, the striking of flakes from the core on which will be produced tools (projectile points, drills, scrapers, etc.); the third step sees the actual shaping and finishing the tool on the flake blank. Hereafter, simply for convenience, these

TABLE 3.—MEAN FREQUENCIES OF LITHIC WASTE PER ROOM, BROKEN K PUEBLO

Floors	North Wing	East Wing	South Wing	West Wing
Stage I	23	19	7	7
Stage II	42	49	27	21
Stage III	13	22	6	3

three categories of debris will be referred to as: Stage I, Stage II, and Stage III, respectively.

For this analysis, the site was treated as consisting of four major room blocks or wings: North Wing: (rooms 24–40); East Wing (rooms 1–23); South Wing (rooms 72–91); and West Wing (rooms 41–71).

Table 2 presents summary figures for the actual frequencies of lithic waste by wing for all floors and for lumped fills. From these data it is clear that: (1) in any room, stage II debris has the highest counts from both floor and fill; (2) in all wings but the east wing, stage I is second in abundance; in the east wing, stage III is the second most abundant class; (3) the north wing has the most material representing stage I, followed by the east, west, and south wings in that order; (4) for both stages II and III, the order is east, north, west, and south wings. Arguing from total density figures, the order is east wing, west wing, north wing, and then south wing. If only floors are considered, the order is somewhat different: east wing, north wing, west wing, and then south wing.

Several generalizations are suggested from these data. Arguing from gross density of lithic waste, by far the most knapping activity was carried out in the rooms in the north wing. Looking at mean frequency of waste materials on floors per wing, the following pattern emerges: north wing and east wing had between two and three times the number of waste items on floors compared to rooms in the south and west wings. This bimodal distribution suggests that two to three times as much knapping activity was carried out in the north and east wings as was true for the south and west wings. This has special impact when compared to the distribution of certain classes of tools which functioned in the preparation of arrows and points, such as antler flakers and wrenches, shaft smoothers, and so on. These items, too, have a patterned distribution at the site.

From these data, I have argued elsewhere (Longacre, 1966) that there might have been a pattern of reciprocal exchange in operation at the site. The waste debris counts might add support to that suggestion, but there is no clear correlation except for the north wing which is high in both such tools and lithic waste.

This gross pattern held true when the counts were broken down by stage of manufacture as well. That is, no one wing was high in stage I debris and low in waste representing stages II and III. Table 3 presents mean floor counts by wings and by stages of manufacture. Essentially the same pattern held for fill counts as well.

By far the most striking pattern was observed when location of the rooms in terms of wings of the pueblo was ignored, and room type was examined. Hill (1965) has defined two types of rooms at the site on the basis of such attributes as floor area, presence of floor features, and artifact densities. These he labels storage rooms and habitation rooms. A third type, ceremonial structures or kivas, was also defined. When floor densities of lithic debris were examined using this typology a striking pattern emerged.

The 23 habitation rooms at the site had a mean density of lithic debris of 98 items. The 25 storage rooms had a mean count of only 30. This can be further refined by noting that eight of the storage rooms had floor features. The average count for this sub-type of storage room was 73, a figure nearly as high as the habitation room mean. The remaining 17 featureless storage rooms had a mean density of only 10 items on their floors.

From these data, it is clear that knapping activity was essentially confined to certain rooms in the pueblo, and that these tended to occur in the north and east wings. High counts were also noted on the floors of kivas, except for the plaza kiva. This, in turn, may suggest that such male activities tended to be carried out in both the habitation units themselves and the kivas during the earlier occupation of the site. Then in the later period of the site's occupation, knapping was not carried out in the large, central kiva, but only in the habitation units. This may indicate that such male activity was at first carried out by groups of men in both habitation rooms and kivas, a pattern that became somewhat altered in the later periods when knapping appears not to have been carried out in the large central kiva. This may have implications for our understanding of the changing nature of village integration (cf. Longacre, 1966).

IV. Pottery

By Paul S. Martin

Excavations at Broken K Pueblo, Carter Ranch, Eastern Arizona (Martin, Rinaldo, Longacre *et al.*, 1964) brought forth a total of 26,082 sherds and 28 whole or restorable vessels. Twelve of the whole vessels came from pueblo rooms and 16 from a burial of an adult male (grave placed in plaza and over it, later, room 27 was built.)

The following description is given in the usual taxonomic fashion.

The listing of pottery types and a tabulation of sherd totals for the entire site regardless of location or level follow this discussion. Since Longacre (*in* Martin, Rinaldo, Longacre *et al.*, 1964, pp. 110–122); has given a description of the major decorated pottery type—Snowflake Black-on-white, and its varieties—I shall not duplicate that. Citations for all types are also given in the volume.

The design elements of Snowflake Black-on-white pottery were analyzed by Mr. Stevens Seaberg, artist, formerly on the staff of the Department of Anthropology at this museum. One hundred seventy-nine elements were recognized. Some of these were used by Hill (1965, manuscript) in his analysis of their spatial distribution in order to set forth inferences concerning the social organization of the Pueblo. The distributions of the design elements were related to function of rooms, the loci of social groups, and temporal distributions.

A complete discussion of the uses of the pottery types and the design elements is given in Chapter V of: *Broken K: A prehistoric society in eastern Arizona* by James N. Hill, dissertation submitted to the Department of Anthropology, University of Chicago, 1965; to be published by Field Museum of Natural History in *Fieldiana: Anthropology*.

The whole pots (except for those with the burial) all came from the north, west, and south wings. Their exact location, shapes, names, and chronological placement are given in the listing at the end of this Chapter.

Binford has called my attention to the fact that taxonomic classification varies in usefulness, depending on the problems being studied. Analysis of the variations in forms—manufacture, shape, designs on the finished products—might help to understand the function of the pots, and

the social context in which they were created. Indeed, such a study might give us clues as to the social structure of a given village; might help explain processes of social change, and give us some hints as to the articulations of extinct cultural systems.

Fig. 89. Bowl. Cat. No. 282877. Snowflake Black-on-white; Hay Hollow variety; associated with burial #1.

A study on the morphological characteristics of pottery as suggested by Binford was begun by Phillips (1965–M.A. dissertation, University of Chicago), using pottery from Broken K Pueblo.

This functional analysis was hampered by three difficulties: 1.) The textured pottery had been classified in the traditional manner and counted, but the sherds were discarded, as had been our custom for 30 years. Thus, thousands of sherds and inferentially hundreds of shapes and sizes, were excluded from the study because of adherence to tradition. 2.) The number of decorated sherds (Snowflake Black-on-white [all varieties], Show-Low Black-on-red) that were large enough to show a complete design element and vessel shape was small (4500 sherds); 3.) and when that number was again cut by using decorated sherds from floors only, our sample size was disappointingly very small. In spite of these drawbacks, some useful data were recorded.

Fig. 90. Bowl, Cat. No. 284074, Springerville Polychrome; room 92; floor #1; bin.

Fig. 91. Bowl. Cat. No. 282971, St. Johns Polychrome; room 48; level A.

A few significant conclusions are herewith given:

1. Black-on-red bowls were more than twice as abundant as Black-on-white ones.
2. Black-on-red jars and pitchers were not present at the Broken K Pueblo.

Fig. 92. Bowl, Cat. No. 282974, St. Johns Polychrome; room 53; floor #1.

3. Black-on-red bowls are more frequent in late rooms than are Black-on-white bowls. This may be a functional replacement as Black-on-white jars are abundant in both early and late rooms.

A male who was from 18 to 30 years old was buried in a deep (1 m.) pit under the south wall of room 27. It was very clear that the interment had taken place before that room was built, and that the burial was placed in what had formerly been part of the plaza.

In addition to a bracelet and necklace of stone beads, 16 pottery vessels were found with this burial. A list of the pottery follows:

3 bowls; St. Johns Black-on-red
1 jar; Snowflake Black-on-white; Hay Hollow variety
1 bowl; Snowflake Black-on-white; Hay Hollow variety
2 jars; Snowflake Black-on-white; Snowflake variety
1 bowl; Snowflake Black-on-white; Snowflake variety

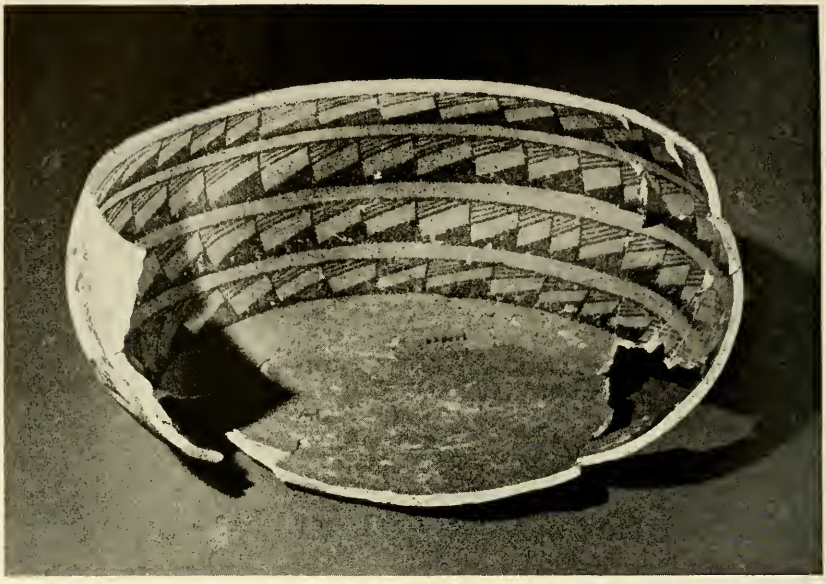

Fig. 93. Bowl, Cat. No. 283476, St. Johns Polychrome; room 69; level B.

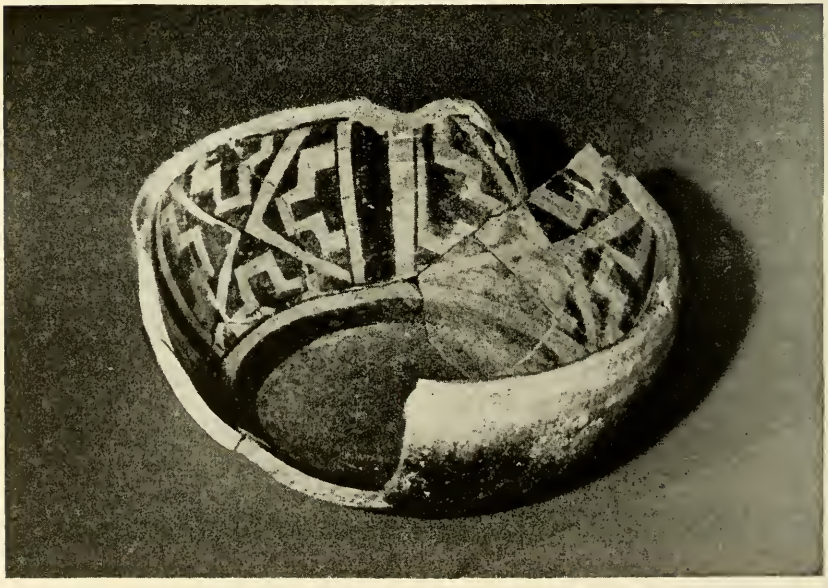

Fig. 94. Bowl, cat. No. 283477, Pinto Polychrome; room 69; level B.

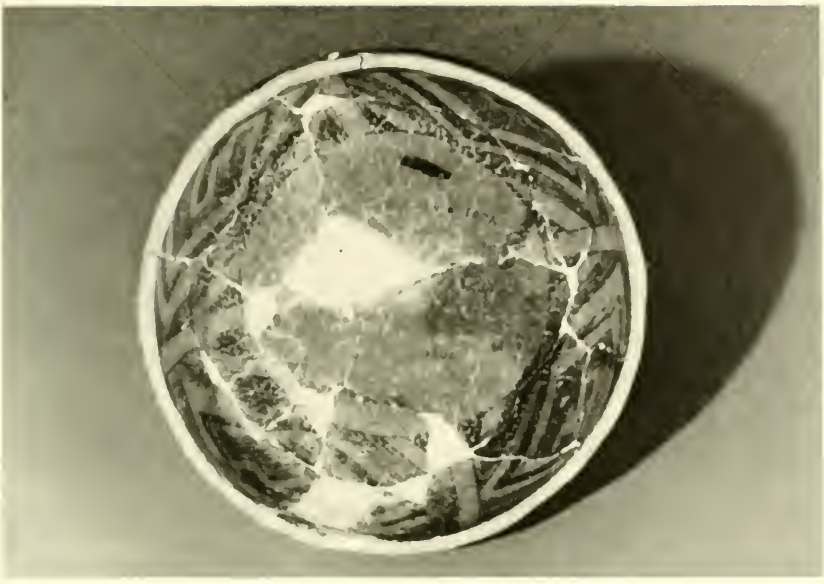

Fig. 95. Bowl, Cat. No. 282891, Querino Polychrome. Associated with burial #1.

Fig. 96. "Canteen," Cat. No. 284075, Snowflake Black-on-white: Carterville variety room 80, floor #1.

1 bowl; McDonald plain corrugated

3 bowls; McDonald indented corrugated

3 jars; Brown indented corrugated

1 jar; Patterned corrugated.

No midden or trash areas, as such, existed, although we searched for them on all sides of the pueblo, and in the plaza. A few sherds in ash soil were noted on the east side of the pueblo but the layer was thin (5–10 dm. thick). This deposit overlay the sandstone bed rock which, everywhere around and within the pueblo, outcrops at the surface or is buried by only a few centimeters of soil. Bed rock was found in the rooms sometimes at, or just below, floor levels.

If a thicker layer of trash existed centuries ago and has been washed away, we found no evidence of it.

Although Broken K Pueblo is larger (by over 50%) than Carter Ranch Site (Martin, Rinaldo, Longacre *et al.*, 1964) about 30% fewer sherds were recovered from the former. (Broken K Pueblo, about 26,000 sherds; Carter Ranch Pueblo, about 34,000). All dirt was sifted at Broken K Pueblo, none at Carter Ranch Pueblo; and yet fewer sherds at the former!

No adequate explanation for this discrepancy is at hand. I suggest that the difference in quantity of sherds might be explained, 1.) by a

Fig. 97. Jar, Cat. No. 282879, Snowflake Black-on-white: Snowflake variety; burial #1.

Fig. 98. Jar, Snowflake Black-on-white, Carterville variety; room 69; levels B, C, and floor #1, parts of the rim from room 4, level B.*

shorter occupation; 2.) by the manufacture of less pottery, since pottery may have declined in importance due to difference in storage and cooking techniques, or due to the fact that there may have been less food to store or cook.

Along with these explanations, I would note that only two burials were found at Broken K Pueblo, as against 34 at Carter Ranch Pueblo. Where interments were made is not known.

LIST OF WHOLE OR RESTORED POTTERY VESSELS, BROKEN K PUEBLO

Bowl —Snowflake Black-on-white, Hay Hollow variety; associated with adult male burial (#1); under north wall of room 27 (282877) (Fig. 89)

Bowl —Springerville Polychrome; room 92, floor, at west edge of grinding bins (284074) (early) (Fig. 90)

Bowl —St. Johns Polychrome; room 48; fill, level A; (282971) (late) (Fig. 91)

Bowl —St. Johns Polychrome, room 53, floor 1 (282974) (late) (Fig. 92)

Bowl —St. Johns Polychrome; room 69, fill (level B); (283476) (late) (Fig. 93)

Bowl —Pinto Polychrome; room 69, fill (level B); (283477) (late) (Fig. 94)

Bowl —Querino Polychrome; associated with adult male burial (#1); under south wall of room 27; (282891) (Fig. 95)

Canteen—Snowflake Black-on-white, Carterville variety, room 80, floor 1; (284075) (early) (Fig. 96)

Jar —Snowflake Black-on-white, Hay Hollow variety; associated with adult male burial (#1); under south wall of room 27 (282879) (Fig. 97)

Fig. 99. Jar, Cat. No. 282970, Snowflake Black-on-white: Hay Hollow variety; room 69, east wall trench.

Fig. 100. Jar, Cat. 282868, Snowflake Black-on-white: Snowflake variety; room 41; floor #1; Pit A.

Fig. 101. Jar, Cat. No. 284076, Snowflake Black-on-white: Snowflake variety, room 39, level B.

Fig. 102. Jar, Cat. No. 283245, Snowflake Black-on-white: Snowflake variety, room 33, pit O.

Jar —Snowflake Black-on white, Showflake variety (also called Tularosa and/or Pinedale Black-on-white?); room 69, fill, (levels B, C) and floor; and rim portions from room 4 (across plaza) fill (level B); (283475) (late). As noted here, pieces of this jar came from two different areas separated by the width of the plaza. Why the pieces were hurled in this fashion is not known. Obviously, it may represent a part of the terminal occupation of the pueblo (Fig. 98)

Jar —Snowflake Black-on-white, Snowflake variety; from trench along inner east wall of room 69 (282970) (early?) (Fig. 99)

Jar —Snowflake Black-on-white, Carterville variety; room 41, pit A, floor (282868) (late) (Fig. 100)

Jar —Snowflake Black-on-white, Snowflake variety; room 39; fill (level B); (284076) (late) (Fig. 101)

Jar —Snowflake Black-on-white, Snowflake variety; room 33, floor, pit O (283245) (early) (Fig. 102)

—Snowflake Black-on-white, Snowflake variety; room 33, floor, pit O (283244) (early) (Fig. 103)

Jar —Snowflake Black-on-white, Snowflake variety; male burial (#1); (282887) (Fig. 104)

Fig. 103. Jar, Cat. No. 283244, Snowflake Black-on-white: Snowflake variety; room 33; floor #1, pit O.

TABLE 4.—SHERD* TOTALS FROM ALL ROOMS (FILL AND FLOORS), FROM THE PLAZA, FEATURES OUTSIDE OF THE PUEBLO PROPER AND FROM THE FOUR OUTLYING ROOMS—BROKEN K PUEBLO,

Decorated Pottery Types	*No.*
Houck Polychrome	4
Kiet Siel Polychrome	1
Pinedale Black-on-red	1

FIG. 104. "Seed" jar, Cat. No. 282887, Snowflake Black-on-white: Snowflake variety, Burial 81.

Pinedale Black-on-white	19
Pinedale Polychrome	21
Pinto Polychrome	65
Querino Polychrome	28
St. Johns Black-on-red	878
St. Johns Polychrome	1,099
Show Low Black-on-red	703
Snowflake Black-on-white, Snowflake variety	2,648
Snowflake Black-on-white, Hay Hollow variety	115
Snowflake Black-on-white, Carterville variety	1,682
Snowflake Black-on-white, Broken K variety	196
Snowflake Black-on-white, Tularosa variety	646
Springerville Polychrome	28
Tusayan Black-on-white	1
Wingate Black-on-red	14
Indeterminate Black-on-red	719
Indeterminate Black-on-white	3,763
Indeterminate Red	52
Indeterminate White-on-red	37
Indeterminate Polychrome	81
Sub-total—Decorated Types	12,801

Textured Pottery Types	No.
Brown plain corrugated (jars)	600
Brown plain corrugated, smudged interiors (bowls)	456
Brown indented corrugated (jars)	8101

Brown indented corrugated, smudged interiors (bowls)	595
Gray indented corrugated (jars)	261
Gray patterned corrugated (jars)	10
Incised corrugated (jars)	4
McDonald corrugated, plain (bowls)	74
McDonald corrugated, indented (bowls)	722
McDonald corrugated, patterned (bowls)	38
Orange indented, corrugated (jars)	12
Patterned corrugated (jars)	283
Patterned corrugated, smudged interiors (bowls)	31
Punched, smudged interior (?)	2
Punched, corrugated (jars)	6
Red indented corrugated, smudged interior (bowls)	2
Sub-total—Textured Pottery Types	11,578

Plain Pottery Types	*No.*
Alma plain	376
Alma smudged	9
Forestdale plain	971
Forestdale smudged	144
Forestdale red	24
Lino Gray	62
Reserve smudged	28
San Francisco red	1
San Francisco red, Smudged interior	12
Woodruff smudged	25
Indeterminate	51
Sub-total—Plain ware types	1,703
Grand Total	26,082

* Complete breakdown of all sherd counts by types and levels is published in Archives of Archaeology No. 27, Society for American Archaeology, and the University of Wisconsin Press, 1966.

Note: All the plain pottery types came from pit houses, the floors of which were about 2 m. below the present surface. These earlier houses were beneath rooms 33, 48, and 41-kiva. Since the plain wares did not pertain to the pueblo proper, Hill omitted them in his counts.

V. Dating of Broken K Pueblo

By Paul S. Martin

Sixteen samples of wood or charcoal were selected for dating out of the 35 obtained.

Six were sent to Isotopes, Inc., Westwood, New Jersey; five to Dr. J. C. Vogel, Director, Natural Science Laboratory, Royal University, Groningen, The Netherlands; and five to Dr. Bryant Bannister, Laboratory of Tree-Ring Research, University of Arizona, Tucson, Arizona. We gratefully acknowledge the aid we have received from these laboratories.

Four samples sent to the Laboratory of Tree-Ring Research were not datable.

One sample from Room 11—a north-south roof beam—was cut into three pieces and sent to the three laboratories. The three dates from the three laboratories on this one room are close (GRN-4555; ULC 75-76; I 1391).

The sample numbers, laboratory, provenience, center dates, one standard deviation dates, and relative dates are given in Table 5.

My colleague, Dr. Hill, has dated Broken K Pueblo (Hill, 1965, Chap. II) at A.D. 1150–1280. These dates were based primarily on fourteen pottery types that have been previously dated by association with tree-ring dates and on C-14 dates.

The range of the assigned dates for these pottery-types is A.D. 1050 to A.D. 1385. For statistical reasons, Hill divided these types into two groups: (1) relatively early, A.D. 1050–1250; (2) relatively late, A.D. 1250–1385. He then averaged the dates for each group and this gave him a mean early date of A.D. 1175, and a mean late date of A.D. 1283. He felt that these dates were fairly good considering the limitations of this dating method. He was encouraged when they corresponded well with the six radio carbon dates from Isotopes, Inc. and the single tree-ring date; but, was puzzled by the initial four dates from the Groningen Laboratory, The Netherlands. The latter dates are too early, and Hill felt that they were probably not valid.

The discrepancy between four of the Groningen dates and those from the Isotopes laboratory cannot be fully explained.

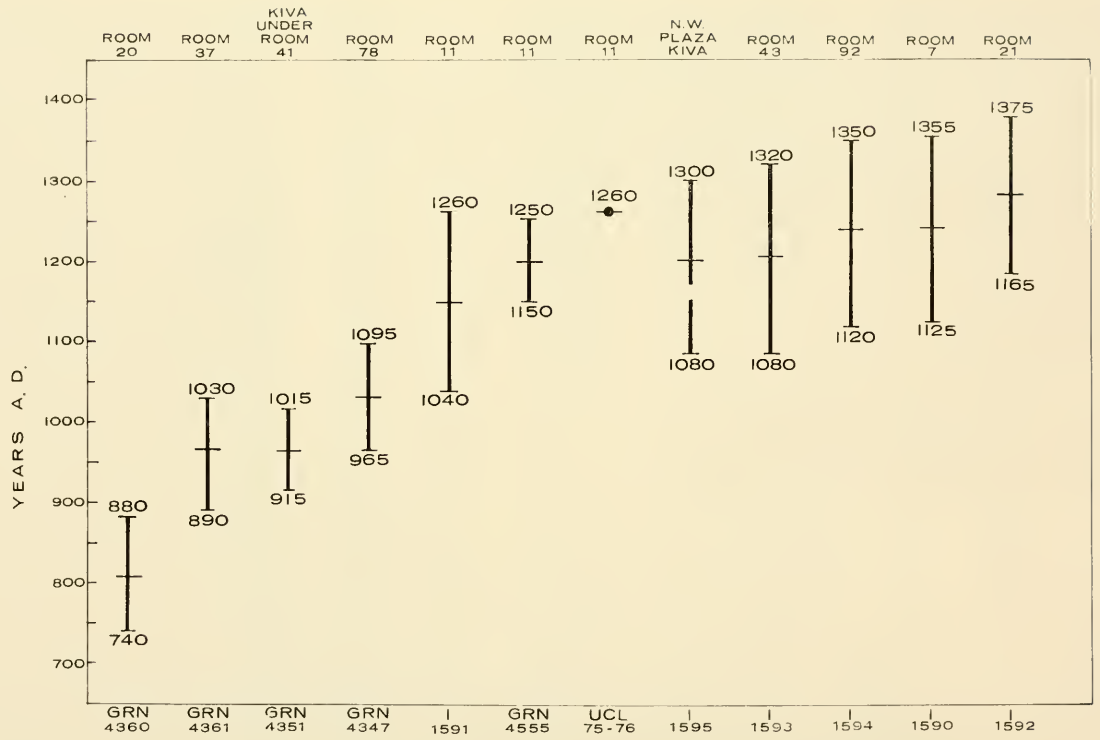

Fig. 105. Chart showing series of radio carbon dates plotted as ranges of time (one standard deviation). GrN = Laboratory at Groningen, The Netherlands; UCL = Laboratory of Tree-Ring Research, University of Arizona, Tucson; I = Isotopes Laboratory.

TABLE 5.—CARBON 14 AND TREE-RING DATA

Sample	Laboratory	Provenience	Dates—Corrected for fractionation	2 chances out of 3 that true age falls within this range—one standard deviation	Relative date from all archaeological data
I-1590	Isotopes	Room 7; Charcoal from firepit	A.D. 1240 ± 115	A.D. 1125–1355	Early
I-1591	Isotopes	Room 11; north-south, roof beam on floor	A.D. 1150 ± 110	A.D. 1040–1260	Early
I-1592	Isotopes	Room 21; charcoal from firepit	A.D. 1270 ± 105	A.D. 1165–1375	Late
I-1593	Isotopes	Room 43; charcoal from firepit	A.D. 1200 ±120	A.D. 1080–1320	Late
I-1594	Isotopes	Room 92; firepit #1 in latest floor	A.D. 1235 ± 115	A.D. 1120–1350	Early
I-1595	Isotopes	NW Plaza Kiva; matting in niche under bench	A.D. 1190 ± 110	A.D. 1080–1300	Late
Gr N-4360	Groningen	Room 20; ashpit	A.D. 810 ± 70	A.D. 740–880	Late

TABLE 5.—CARBON 14 AND TREE-RING DATA (Continued)

Gr N-4361	Groningen	Room 37; firepit below slabs	A.D. 960 ± 70	A.D. 890–1030	Late
Gr N-4351	Groningen	Kiva under room 41; charcoal from firepit	A.D. 965 ± 50	A.D. 915–1015	Early
GrN-4347	Groningen	Room 78; firepit in level II	A.D. 1030 ± 65	A.D. 965–1095	Late
Gr N-4555	Groningen	Room 11; north-south, roof beam on floor. Same beam as above I-1591	A.D. 1200 ± 50	A.D. 1150–1250	Early
ULC 75–76	Laboratory for Tree-Ring Research	Room 11: north-south roof beam on floor. Same beam as above in I-1591 & Gr N-4555	A.D. 1259 vv. the symbol vv. = x no. of outside rings missing	No sigma about A.D. 1259	Early

The difference between these two sets of dates might reflect earlier, unknown activities at Broken K Pueblo. Since, however, there was nothing peculiar about the four samples from which Groningen obtained measurements, except that they were all contained in one single shipment, we suspect that contamination occurred in shipment or in packing that uniformly altered all four dates.

It should be emphasized that there was no reason *a priori* to suspect the four Groningen dates all to be different since their contexts within the Pueblo were in no way peculiar. The samples were not all drawn from kivas or storage rooms, or from any other unique locus. We argue, therefore that the four aberrant dates do not represent a tendency on the part of the Indians to reuse beams from abandoned, old structures in any particular type of room.

I wanted however, to pursue the matter a bit further by plotting all the radio-carbon dates (Isotopes, Groningen) as ranges of time, taking into account the calculated standard deviation (Fig. 105). I hoped there might be an overlap of ranges of time and that this might pull all the dates together and produce a more plausible time sequence.

On a whole, the results were disappointing, although it did show that the six Isotope dates, the tree-ring date, and one date from Groningen were internally consistent.

I noted that the center date for Hill's ceramic dating span is A.D. 1229 (mean early A.D. $\frac{1175}{2}$ + mean late A.D. $\frac{1283}{2}$. This center date is very close to the center dates for all the Isotope measurements and to one measurement (Room 11) from Groningen. It is also very close to the one tree-ring date (part of identical log from Room 11 that was divided into three parts and sent to the three laboratories).

For the purposes of experiment **A** (below) I did not use the four measurements from Groningen that appeared to be too early by several hundreds of years. It should be noted again that these measurements were derived from four samples all of which were sent to Groningen in one shipment and were run as one series. Experiment A was performed to see what the range of dates would be outside of this block of dates.

A 1. I found the mean of the fractionated C 14 dates for all Isotope runs and one run from Groningen.

2. I also found the mean of all the standard deviations referred to in No. 1.

3. These two operations yielded a possible time span of from A.D. 1108–1315 for Broken K Pueblo.

B. I next averaged *all* the fractionated C 14 dates and *all* the standard deviations and came up with a range of dates from A.D. 1024–1202 for Broken K Pueblo.

Since Hill's center date fits well into the range of the dates from experiment A, and also well with the tree-ring date, and since the range attained from experiment B does not include the tree-ring date and does not accord well with the dates obtained from pottery, we then accept Hill's chronology—A.D. 1150–1280.

VI. The Problem of Sampling

By James N. Hill

INTRODUCTION

Before discussing the nature of the sampling techniques employed at Broken K Pueblo, it will be worth while to examine briefly some of the important aspects of sampling theory which are of concern to archaeologists. While I make no pretense to presenting a highly sophisticated exposition of a complicated subject (for which I am not competent), it is important that some consideration of sampling theory be presented as background material for understanding and evaluating the procedures employed at Broken K Pueblo. This discussion may also be of some interest, in itself, since the problem of sampling is one of the archaeologist's fundamental concerns, and since there is still a great deal of confusion surrounding the subject. Excellent theoretical discussions of archaeological field sampling are found in Vescelius (1960), Binford (1964), and Rootenberg (1964). I am indebted to these writers for much of the following discussion.

THEORY

It is perfectly evident that the best way to obtain accurate and complete information about an archaeological site is to excavate it completely. Even when this is done, of course, it is impossible to recover all of the facts and materials that may be of interest in the present or in the future. The most that can be asked is that we collect the data necessary to the solution of our problems, as well as such other data as our colleagues have a right to expect. In a sense, then, a site can never be completely excavated.

In most cases, even an approximation to complete excavation is not possible, except perhaps in the case of very small sites. The exigencies of available time, money, and personnel generally require that a *sample* of some kind be taken. However the sample is chosen, and whatever its size, it usually serves as a base from which to make inferences about the site as a whole.

If one is interested in obtaining a truly representative sample of the remains of an entire prehistoric community, then it is clear that not all of the available sampling techniques are equally useful. It would, for example, be inadvisable to regard the material from a single test pit or trench as representative of the range of variation in form throughout a community. This would be analogous to regarding the contents of a modern kitchen as representative of the artifacts and activities of other rooms in a house. Clearly, most of the items found in a kitchen will not be very informative with respect to the activities carried out in a bathroom, bedroom, living room, or service porch—and we would not want to make inferences about these rooms (or the house as a whole) without sampling them. The same kind of argument holds, of course, for sampling within any universe or population. If the sample is not truly representative of the universe being studied, then it is dangerous to use it as a basis for generalization about that universe.

One of the most common types of sampling technique in the Southwest is "block" excavation. This involves opening up one or more large, contiguous portions of a site, leaving the remainder untouched. This method of sampling is clearly more desirable than excavating one or two test pits or trenches; but as it is generally practiced, it suffers from most of the same drawbacks. Unless these excavated "blocks" are strategically located in all major portions of the site, the information they yield will almost certainly be biased. The possibility exists that one could excavate half of a site, and recover information about half of a sociocultural system!

A vast amount of energy has been expended in attempts to describe and compare prehistoric "cultures" on the basis of biased samples. It is frequently the case, for example, that a small sample of sherds is taken from a site; this sample is then considered to represent the "norm" for pottery at the site, and this "norm" is compared with a similar biased "norm" from other sites. If two or more sites appear to contain very similar pottery, then they are considered closely "related" in some sense; if the samples are very different, then the sites are more distantly related. This kind of comparison is dangerous, in part, because it is possible that the samples drawn from the various sites are not representative of all of the pottery existing at the sites. In some sites the sample may have been drawn from a burial area, while in others it may have come from a cooking, butchering, or trash area. One would expect the samples of pottery (and other artifacts) found in these functionally different areas to be different from one another, simply because different kinds of activities (and possibly social units) often employ different kinds of pottery. Regarding a sample drawn from one or two of these activity-areas as repre-

senting a "norm" simply covers up the probability that there is important functional and spatial variability within a site (Binford, 1964, p. 433).

It is apparent, then, that we will not be able to get at this variability by excavating a small, localized area of a site. If we are profitably to describe and compare prehistoric sociocultural systems, we must obtain representative samples of the sites involved. If a site must be sampled (as opposed to complete excavation), then it should be sampled in such a way that *all* portions of it are represented in some degree.

This is not to say that test pits, trenches, "block" excavations, and the like have no worthwhile uses; they may profitably be employed in a number of specific situations. In general, however, they are not sufficient for deriving information about complete prehistoric communities. They are most frequently used by archaeologists who want to obtain relatively small samples of sherds or other artifacts to use in studies of taxonomy, chronology and the spatial distribution of traits. Even for these kinds of culture-trait studies, however, there is some doubt that a biased sample would be very useful.

Another point with respect to sampling-theory is also of interest here. There are many instances in which archaeologists have been highly *selective* of the kinds of data they recover and analyze. While some selectivity is obviously necessary, it is easy to create serious biases by emphasizing certain kinds of cultural material to the virtual exclusion of others. An emphasis on pottery, projectile points and burials, for example, will restrict the analyst's inferences to certain aspects of those sets of data. It would, in such a case, be impossible to learn very much about a complete sociocultural system (Binford, 1964, p. 433; Rootenberg, 1964, p. 187).

Given this interest in complete systems (structural-functional analysis), it is also important that all areas within a site are sampled in a *comparable* manner. Otherwise, it will be extremely difficult to compare various subareas within a site with respect to their differential frequencies of culturally relevant materials. If, for example, the excavator screens most of the soil deposits in half of his site with a one-fourth-inch screen, but does not screen the other half, it is likely that there will be a great difference in the amount (and even the nature) of materials recovered in each half. Comparisons of the differential densities of artifacts between the halves would then be misleading. If, on the other hand, the sampling procedures are essentially the same in all portions of a site, then one can begin to interpret differential densities of materials in terms of differences in function (activity), differences in social units, or temporal changes in these things. In short, if samples are obtained in a comparable manner, then one of the possible sources of sample variation and error is eliminated —and this, of course, reduces the complexity involved in interpretation.

It appears, then, that a truly representative sample is one that covers all areas of a site to an equivalent degree. One way of obtaining this kind of sample would be to use some form of systematic sampling. One could, for example, excavate all of the odd (or even) numbered rooms or grid-squares at a site. This would, in general, be superior to the "block" excavation technique. It has its drawbacks, however, since it is possible that the units not excavated might consistently contain important classes of information not found in the excavated ones. While this seems somewhat improbable with respect to many sites, it could certainly happen if the site involved had been laid out in a systematic way by the prehistoric inhabitants (e.g., a grid or checkerboard system).

It is becoming increasingly apparent that the easiest, most efficient way to obtain a relatively "unbiased" sample is to utilize some form of probability sampling (random sampling). Although this does not preclude the possibility of "sampling error", it clearly minimizes such error. J. G. D. Clark (1960, p. 125) views the situation as follows:

> . . . if we are to apply quantitative methods of analysis to settlement debris successfully, we must either totally excavate a site, which is only possible for certain rather primitive states of culture as a rule, or we have to devise some system of sampling which approximates, as far as is possible, perfect random sampling.

Such a method, by definition, gives each of the units to be samples (e.g., rooms, grid squares, etc.) an equal chance of being chosen for excavation (cf. Parten, 1950; Walker and Lev, 1953, p. 10). It virtually eliminates the possibility that the excavator will consciously or unconsciously select areas to excavate which he feels, for one reason or another, are most "desirable." In other words, it serves to prevent a common form of sampling bias. It also allows us accurately to measure the reliability of a sample, and it permits us to predict the numbers of various kinds of culturally related materials that we would *probably* find in the unexcavated areas of a site. In short, random sampling permits us to make "probability statements"; and these are often not possible if one uses other forms of sampling.

It is not possible to go into detail here with respect to the theory and applications involved in probability sampling. These are amply discussed in a number of publications (cf. Deming, 1950; Vescelius, 1960; Binford, 1964; Rootenberg, 1964). It will be worthwhile, however, to discuss briefly the two *basic* kinds of probability sampling—"simple" and "stratified"—and to attempt to answer some of the criticisms that are frequently levied against the use of such sampling in archaeology.

A "simple" random sample is one in which *all* of the units of the sampled universe (i.e., site in this case) have an equal chance of being chosen.

All of the units or items in the population, whether they be rooms, grid squares or artifacts, are treated as equivalent. Each should be the same *size*, and they should be independent of one another (for other requirements, see Parten, 1950). Each sample unit is then assigned a number in a systematic manner. Then, after the desired sample-size has been determined, the units that will actually be selected are determined with the aid of a table of random digits, such as that published in Arkin and Colton, 1961.

It is not possible, of course, to sample in random manner all of the cultural materials in an archaeological site. In order to do this, it would first be necessary to excavate the site and number all of the artifacts and other materials in the process of selecting the sample. This would defeat the purpose, since the entire site would already have been excavated and a sample would be unnecessary (Rootenberg, 1964, p. 182). Nonetheless, it is possible to use a simple random sampling technique on an archaeological site if one chooses natural units (such as rooms or depressions) or artificial units (such as grid squares) as the sample units making up the population. This would yield a random sample of the units chosen, *not* of all of the culturally relevant material at the site.

A stratified sample is one in which the universe being studied is not considered as an undifferentiated whole. Instead, the analyst divides the universe (site) into different sub-populations, and then resorts to taking a simple random sample of equivalent units within each subdivision separately. This is desirable whenever previous knowledge of a site permits dividing it into two or more different classes of units. Recognizable house depressions, for example, would not be lumped with the undifferentiated squares of a grid system; they are clearly different populations, and should be treated separately. Such a method of stratified sampling can increase precision without increasing the total sample needed (Binford, 1964, p. 429).

An interesting and sometimes useful variant of random sampling has been suggested by Vescelius (1960), Binford (1964), Rootenberg (1964), and others. This consists in selecting the *first* sample unit (e.g., grid square, etc.) in a random manner, then selecting all subsequent units in terms of a pre-established *interval*. For example, one might select a single grid-square for excavation by using a table of random digits, and then excavate every third square, counting from the initial one. This sampling technique has the advantage of ensuring equal dispersion of sample units throughout a site, and it is particularly desirable when one is interested in determining density clines and comparisons of the densities of various culturally related items in space (cf. Binford 1964, p. 435).

Regardless of whether this sampling technique or one of the others mentioned is used, the problem of sample *size* must be faced; and this has been given only scant attention in the archaeological literature. It would seem that, in general, the size of the sample selected will be a function of the archaeologist's problems, and his estimate of how large the sample must be to provide enough information for their solution. Vescelius (1960, p. 462) notes that ". . . a sample of 5 or 10 per cent" of the units of a population is enough. Rootenberg's survey of the statistical literature, on the other hand, leads him to believe that there is no single optimum sample size, and that the size chosen should depend on the degree of heterogeneity within the population. Although this entails knowing (or estimating) something about an archaeological site prior to excavation, it is clearly the most reasonable approach. If we assume, for example, that a site is extremely homogeneous with respect to its contents, then a very small sample should be adequate; if the site is suspected of a high degree of heterogeneity, then a larger sample is required. The method used in determining sample size at Broken K Pueblo is outlined in the succeeding section of this paper, and it seems adequate for the purposes for which it was designed. A method for determining sample reliability *after* the sample has been collected has been given by Vescelius (1960).

Before closing this theoretical discussion, there are two frequently heard criticisms of the applications of probability sampling in archaeology that should be discussed. One of these is that archaeologists who employ such techniques are blind slaves to the techniques themselves. In other words, it is often believed that the employment of random sampling obviates (or suppresses) archaeological expertise. This criticism is, of course, unjustified as long as such sampling is not considered an end in itself. The purpose of random sampling is primarily to show the excavator what kinds of things will likely be found (spatial distribution). Random sampling is simply a quick and relatively inexpensive way to do this. The initial sample serves to point out those aspects of the site which may require additional excavation. This sample should shed more light on the structure of the site than was apparent prior to excavation. One might then profitably subdivide the site in accordance with this discovered structural differentiation, and structure simple random samples of each subdivision separately (stratified sampling). This process of discovery and re-structuring of the sample ("phase" or "stage" sampling, Binford, 1964, p. 438; Vescelius, 1960, p. 461) could, theoretically, go on indefinitely—or until the excavator is satisfied that he has learned enough. It may be that, upon reaching a certain point, he will want to abandon random sampling altogether.

It is likely that as the site is being excavated (in a random manner) a number of the excavated units will contain only *part* of an important feature of some kind. The remainder of such a feature is then to be found in another unit—but *outside* the random sample. Are we to excavate only that part of a feature that happens to fall within the initial sample? Clearly not. In most cases it will be decided that complete features will be excavated. One might simply decide, ahead of time, that any feature encountered in a randomly selected unit will be excavated in its entirety—except in those cases in which the information to be derived by doing so is insufficient to warrant the effort.

Probability sampling, then, need *never* obviate archaeological expertise. When it does it is, *ipso facto*, being misused. It should only be used in sampling populations of items (of any nature) that can be assumed to be relatively homogeneous (as far as the excavator can determine). In other words, it is used to sample a universe that is unknown with regard to content. When content is known, the sample can be structured or stratified accordingly. It is important that there be a continuous interplay between field work and analysis.

The second frequently heard criticism of this kind of sampling is that it can be equated with "haphazard" or "grab" sampling. This is an uninformed and wholly unjustified criticism, however, since probability sampling is not at all equivalent to "haphazard." The terms "random sampling" and "probability sampling" are technical statistical terms to designate a highly systematic sampling technique. The rules of the game are strict and measures of reliability are easily derived. If one of the most "interesting" structures in an archaeological site should not happen to fall into the initial sample, this does not mean that it cannot be excavated. If it is unique, it can be sampled as an independent, homogeneous unit—a sub-structure of the site. As previously mentioned, the sample is useful in elucidating what is in the site—it does not govern the excavator's judgement of what is important.

SAMPLING AT BROKEN K PUEBLO

Since Broken K Pueblo was a rather large site (nearly 100 rooms), it was not possible to excavate it completely. Furthermore, since we were concerned with learning as much as possible about the activity structure and social organization of the entire community, it seemed necessary that our sample cover the entire site to some degree (even coverage being most desirable). This clearly precluded the use of a few test pits, trenches or "block" excavations—for most purposes at least. Although consideration was given to the idea of excavating every other room, in checkerboard

fashion, it was decided that a random sample would give adequate coverage. In addition, it would be much less biased than any other sampling system we might devise, and it would permit the making of probability statements. It should be mentioned, however, that our application of probability sampling was not as well done as it might have been; and this will become apparent to the reader. It was, nonetheless, relatively successful; and it may be as instructive to others as it was to us.

The first "bias" to creep into the situation involved the definition of the universe to be sampled. This, of course, was the *site*. Instead of sampling the entire site in a random manner, however, it was decided that this technique should be applied to the *rooms* only (Fig. 1). Other portions of the site, such as the plaza and the sheet trash surrounding the roomblocks, were sampled with trenches. As a result, these areas were not as systematically or as thoroughly sampled as were the rooms—and probability statements concerning them would not be easy to formulate. In short, the population chosen for random sampling consisted of rooms only (all except the outliers); so the opportunity of stratifying or structuring the entire site in terms of probability sampling was overlooked.

The first step in setting up the sample of rooms was to uncover as many of the walls at the site as was necessary in order to make a rough ground plan of the site. This was done in about three weeks time, and it is believed that no more than two or three surface rooms were missed. Following this, all of the rooms were assigned numbers consecutively, from 1 to 92. This could not include subterranean rooms, of course, since their existence was not known prior to excavation.

It is worth noting that one of the surface rooms (room 92), which is located in the west wing, was not discovered in the initial wall trenching operation. It thus did not receive a number during the systematic numbering procedure. It was not possible to renumber the rooms to include it in sequence, since excavation had already begun in a number of rooms. Renumbering would have excluded some of the rooms from the sample that were already being excavated. Their numbers would have been changed such that they would no longer be a part of the selected sample; and conversely, other rooms would have had to be substituted. Further, it would not have been statistically legitimate simply to select an entirely new sample.

After all of the walls had been located, it should have been obvious that some of the rooms were very small and others were very large. There were, in fact, two statistically significant classes of rooms, and possibly three, based on size alone. This bimodal distribution was not observed, however, until after the site had been excavated. An opportunity to

stratify the population of rooms was thus missed. Instead, a "simple" random sample was selected. This is clearly a case in which there was a lack of feedback, or interplay, between excavation and analysis.

Nonetheless, the large size of the sample selected proved to be adequate to compensate for this error of omission—even though it was necessary to excavate a larger number of rooms than would otherwise have been necessary to achieve the same results.

The sample size (number of rooms) necessary to give the desired results was determined with the aid of tables of the cumulative binomial distribution (Aiken, 1955). These tables indicated that a sample of 50 percent of the rooms (46 rooms) would give us a 90 percent chance (probability of .90) of discovering *at least one* of any item which might occur only five times at the site (in five different rooms); and there was a 41 percent chance of finding at least three of these hypothetical items. It was also determined that there was a probability of .99 of discovering at least one of any items occurring in only ten rooms, and a probability of .61 of getting one of any item occurring only twice at the site. This seemed ample for our purposes since, for statistical reasons, we were primarily interested in obtaining a representative sample of relatively *common* materials at the site. A sample of 50 percent virtually assured us that such items would be well represented; and even many of the less common items would be represented as well.

Accordingly, 46 rooms were chosen from a table of random digits (Arkin and Colton, 1961), and the selected rooms were excavated in the random order indicated by the table. Although this order of excavation was in no way mandatory, it served as insurance against the possibility that we would be unable to complete the entire sample in the time available. By doing it in this manner, it would have been possible to quit work at any time and still have acquired a *random* sample—even though it would have been somewhat smaller than the size desired.

The excavated sample was not considered as an end in itself. It served, as expected, to point up the fact that a number of other rooms needed to be excavated if we were to gain a more or less complete understanding of the total range of variability within the site. Thus, eight more rooms were dug, bringing the total number of excavated surface rooms to 54. This, of course, increased the chances of finding a given number any particular class of item. In fact, a 54-room sample yielded a probability of .95 of finding at least one of any item occurring only five times at the site. This is a very rough approximation, however, since the additional excavated rooms were *not* chosen in a random manner.

Even though additional rooms were excavated, the time and resources available did not permit the excavation of a rather large block of rooms on the east end of the south wing, and a somewhat smaller block in the middle of the east wing (Fig. 1). None of these rooms fell into the initial sample. In short, the site was not sampled as evenly as had been wished; and it was necessary that these blocks be excluded from subsequent analysis. It seems likely that this would not have happened if the sample had been stratified initially, as mentioned above. We now believe that the "ideal" way to have done it would have been as follows:

1. Structure the population of rooms into four separate "wings." The four wings of the pueblo form relatively distinct units; at least this might have been assumed prior to excavation. Thus, each wing should have been sampled separately.
2. Within each wing, the small rooms (2.5-6.6 sq. m. in floor-area) should have been separated from the large rooms (*ca.* 6.6-16.0 sq. m. in floor-area). Thus, the two statistically significant size-classes of rooms should have been sampled as separate populations.

This would have constituted a stratified sample of the entire universe (rooms at the site), which would have included *eight* separate populations. It would have been almost impossible to obtain uneven coverage in this way. The plaza and the surrounding sheet-trash could have been structured as separate random samples, and these might also have been divided internally.

In spite of these drawbacks, the sample was quite productive. One of the important by-products of it was that after the sample had been excavated, it was possible to predict (approximately) the total number of any given item in the entire site, even though all of the rooms were not excavated. For example, there were two surface room-type kivas discovered in the initial 50 percent sample (room 6-kiva and room 29-kiva). Since the sample was random, we can expect the unexcavated half of the rooms to contain approximately two more such kivas. This same kind of prediction can be made for any other category of item, and the accuracy of prediction increases when dealing with items that occur in relatively large numbers.

It is worthy of note here that if random sampling had not been employed, we would probably have missed several interesting and significant portions of the site. We would have missed, for example, at least three of the six kivas discovered. These kivas were located in areas of the pueblo that were either very badly preserved or had been "potted" by amateurs. The employment of traditional methods of sampling would have led us to select only those areas which were well preserved.

As previously mentioned, the plaza and surrounding sheet-trash at Broken K Pueblo were sampled by trenching. In addition, the plaza was scraped with a tractor blade in order to remove overburden and expose cultural features. Although the sheet-trash was sampled, no true midden area was located outside the main portion of the pueblo. Two large trenches, and a number of exploratory "holes" were dug, but sterile soil or bedrock was found in most places at a depth of less than 20 cm. Although there was no time to obtain a "representative" sample of these areas, it is almost certain that no extensive midden area exists there today.

There were, of course, other important sampling problems faced at Broken K Pueblo, but these were of a somewhat different nature. In addition to determining the rooms and other areas which were to be excavated, it was also necessary to decide on the specific techniques of sampling each of the units that were chosen. It was particularly important that each of these units be sampled in a *comparable* manner, so that differential densities of culturally relevant materials would be readily apparent.

All areas of the site were excavated in terms of natural levels, since such levels were easily observable, and since they were directly referable to rather discrete episodes of natural and cultural deposition. All trash or ash levels of the fill, as well as all materials on the floors, were put through a screen of one-fourth inch hardware cloth. The floor levels were defined as including everything resting directly on the floors or clearly associated with them. This definition of "floor" was employed in an effort to obtain materials which were definitely associated with the rooms, and to exclude those which had been thrown in the rooms after their abandonment. Such a procedure is mandatory if significant inferences concerning room *function* are to be made. In a few rooms, notably rooms 1, 40 and 69, there may have been some mixture of floor and fill materials during excavation; but on the whole, the procedure yielded much more reliable information than could have been obtained by our previous method of including the 10 cm. overlying the floor as "floor."

The rooms ranged in depth from about 20 cm. to 110 cm. The "typical" room was about 60 cm. deep, and usually contained three natural levels, including the floors, as follows:

Level	Thickness	Characteristics
A	Surface—40 cm.	Brown humus and sand; windblown and waterwashed; fallen wall stones; no trash or cultural debris (except an occasional item that had been washed in).
B	40–59 cm.	Red sand or clay; deposited primarily by water; trash occasionally; sometimes roof beams.
Floor	59–60 cm.	Hard packed red sand or grey plaster, *ca.* 2 cm. thick (sometimes somewhat thicker, and including a temporal accumulation of debris).

A few rooms had more than one floor, with later floors having been plastered over earlier ones; and in some rooms there was a trash or sterile layer intervening between floors.

All floors were troweled and swept, and features were carefully excavated and recorded. Artifacts recovered from features were "bagged" separately, although this separation was not found useful in the analysis. After a floor had been photographed, and plans and notes completed, trenches were dug along the walls in an effort to locate any deeper (earlier) floors or sub-floor features.

Charcoal samples were taken from all rooms having any charcoal, and this included most of the "habitation" rooms (the large room category) at the site. Very little charcoal could be found in storage rooms, because these rooms rarely contained firepits, and usually had not burned.

An effort was made to collect wood samples suitable for dendrochronological analysis, but nearly all of the wood at the site was *Juniperus* and was found to be undatable, given present techniques. A single date (A.D. 1260) was, however, obtained in this way.

Pollen samples were taken from the floors of most excavated rooms. There were 115 samples taken in a total of 43 rooms—an average of nearly three samples per room. Only 53 were processed and analyzed. Although most of the analyzed samples were taken from floor surfaces (floor plaster or hard-packed earth), two of them were from mealing bins, three were from the bottoms of floor pits, two were from the grinding surfaces of metates, one was from a sample of fecal material found in rooms 31-33, and one was from an infant burial underneath room 34. In addition to this, pollen samples were taken from the natural levels in two stratigraphic sections, and some additional ones were taken from the present land surface (for control).

Not all of the samples yielded pollen, however. Nine of the sampled rooms fell in this category (rooms 25, 36, 41, 43, 54, 64, 65, 69, and 82). Thus, out of a total of 43 sampled rooms, 34 rooms yielded pollen. This is considered a sufficiently large sample to use in distributional studies of pollen types within the site (p. 159).

No materials were consciously discarded during excavation. Everything was saved that could conceivably be of use in studying the site. Even such items as bone, fine chert chips, and seeds were carefully saved; and all such materials have proved exceedingly useful.

After all the materials had been classified and counted, some categories were discarded. It was felt that such items as pebbles, fire-cracked rock, and textured-ware sherds would not require re-examination once they

had been counted. Unfortunately, the textured-ware sherds could have been used in studying vessel form and function; but they can never be recovered.

On the whole, we feel that the site was reasonably well sampled. There were certain gaps, already mentioned, in the evenness of the coverage, but these do not seem to have been as detrimental to the results as we might have expected. Those rooms and areas that were excavated were done in a comparable manner, and it has been possible to use the data obtained in studies of differential density and spatial variability in artifacts, non-artifact materials and features. Some of the results of these studies are reported in this volume, while others await publication.

This experiment in probability sampling may be useful to others because it presents some of the rationale for using such a technique, as well as a number of the specific procedures which should be followed in the attempt. It also suggests a number of procedures which should *not* be followed and in some respects we have learned the hard way. It would be extremely interesting to have the opportunity of excavating the remaining unexcavated portions of Broken K Pueblo to compare the materials and conclusions derived with those we already have. This would seem to be the easiest test of the validity of our sampling methods. I suspect the results would be roughly comparable.

Another interesting experiment would be to choose a sample of an as yet unexcavated site (choosing the sample in some "traditional" manner), and then actually excavate the site in terms of probability sampling. It would be very simple to point to many of the features and materials which would have been missed if probability sampling had not been employed. Both the "traditional" sample (unexcavated) and the random sample (excavated) would have to be held equivalent in terms of the amount of earth involved (size of the sample). If one had the necessary resources, he could then excavate the "traditional" sample and compare results with the first one. It is evident that a number of archaeologists will not be willing to accept the application of probability sampling in archaeology until several such experiments are made. For this reason, they will be worth the effort.

The present discussion has been concerned with the sampling of a single archaeological site; and it is geared to sampling individual sites rather than populations of artifacts, features, or large regions. The principles are, in general, the same, however. An excellent discussion of regional sampling is given by Lewis Binford (1964).

VII. Structure, Function and Change At Broken K Pueblo

By James N. Hill

A recent trend in archaeological research consists in attempting to reconstruct prehistoric sociocultural systems, much as ethnologists describe them. This concern seems to involve two primary tasks: (1) the *description* of past cultural systems in time and space, and (2) the *explanation* of stability and change in these systems. Although there is some concern over the degree to which these goals can be achieved, it is apparent that a certain amount of success is now possible.

One of the prerequisites in this pursuit is the view that prehistoric communities can be studied as "whole" systems, each with an intimately inter-related set of functional parts. The view that culture can be regarded as an assemblage or aggregation of individual and comparable *traits*, on the other hand, does not lend itself well to structural-functional questions. This has, of course, been pointed out by a number of archaeologists, and it needs little support here (cf. Taylor, 1948; Martin and Rinaldo, 1950*b*; Sears, 1961; Binford, 1962, 1964, 1965).

The description of "complete" systems becomes especially important when one is interested in explaining cultural stability and change. The reason for this is that the forces promoting stability and change are almost certainly operative on complete, ongoing systems rather than on aggregates of individual traits. To understand the *processes* of sociocultural change, it seems likely that it will be necessary to study whole systems (insofar as possible) and their relationships to the causal forces involved. Eventually, it may be possible to determine regularities in change; and these may constitute significant contributions to anthropology.

This brief report serves to illustrate some of the kinds of interpretations which structure-function oriented researchers can make of archaeological data. Broken K Pueblo (to which this entire volume is dedicated) is the subject of concern. It should be made clear, however, that this is simply a preliminary report of some of the *results* that have been achieved in the study of Broken K Pueblo. It is necessarily too brief to admit either detailed interpretation or the inclusion of the "raw" data necessary to

support the interpretations. A somewhat more detailed account will be found in Hill, 1966; but the raw data used in this monograph as well as in Hill's publication (1965) are published in Archives of Archeology, (Martin, Longacre, and Hill), no. 27, 1966.

The basic theoretical model employed in the analysis may be stated in the form of two postulates: (1) Since human behavior is patterned or structured, the spatial distributions of cultural materials are also patterned (non-random), and will be so within an archaeological site. These patterns reflect the loci of patterned behavior that existed in prehistoric times. (2) Cultural items and stylistic elements change in form and relative frequency through time, as their associated functions change in nature or relative frequency. Change occurs primarily through the action of selective pressures. In other words, culture is man's extrasomatic means of adaptation to the total environment (physical and social) (cf. White, 1959, p. 8).

A large portion of the data from the site was quantified and manipulated statistically. Three multivariate analyses (factor analyses) were performed on the I.B.M. 7094 computer at the University of Chicago.[1] These analyses permitted the development of non-random clusters of pottery-types and ceramic design-elements; and the clusters or "factors" were used in various distribution studies.

Such distribution studies could not be adequately performed without first controlling the temporal variable within the site. Various lines of evidence, both architectural and stratigraphic, were used in this intra-site dating effort. It was found that the southern portion of the site is, *in general*, earlier than the northern portion, although there is some evidence that the entire site was occupied simultaneously near the end of the occupation (cf. Hill, 1965, 1966).

It is perhaps significant that fossil pollen data were found useful in this respect. A detailed pollen chronology for eastern Arizona indicates a shift in the relative proportions of pollen-types during the time in which Broken K Pueblo was occupied, and this shift was documented within the site itself.[2]

[1] For a discussion of factor analysis, see Fruchter, 1954.

[2] A pollen chronology for the area (Schoenwetter 1962; Hevly 1964) indicated a gradual temporal shift in the relative proportions of pollen types, characterized primarily by decreasing percentages of arboreal pollen (especially *Pinus*) and increasing percentages of non-arboreal pollen during this time period (ca. A.D. 1000–1300). Most of the rooms at the site which, on the basis of other evidence, had been considered "early" contained 20 to 40 percent *Pinus* pollen; while "late" rooms generally contained less than 20 percent. The "late" rooms contained significantly more non-arboreal pollen (especially Compositae, Chenopodiaceae, Amaranthaceae and Gramineae). It would not be valid to claim that pollen data can be used widely in intra-site dating, but further experimentation seems called for.

The next step in the analysis was the establishment of statistically valid room-types. It was discovered that there were two discrete modes of room-size. The small rooms (2.5–6.5 sq. m. in floor-area) generally contained few features or artifacts. They did, however, contain large amounts of the pollen of "economic" plants.[1] The large rooms (6.6–16.0 sq. m. in floor-area)[2] were, on the other hand, associated with firepits, mealing-bins, ventilators, artifacts (including sherds), lithic waste, animal bone and seeds; but they contained very little "economic" pollen.[3] I called these rooms "habitation" rooms; while the smaller ones were designated as "storage" rooms. A third class of rooms was considered "ceremonial", since they contained features in common with Hopi and Zuni ceremonial rooms.

This taxonomy of rooms was designed primarily to permit a determination of variation in the *functions* of the rooms, insofar as these could be discovered. Several of the functions of the rooms were determined by examining the differential spatial clustering (mutual covariation) of both artifact and non-artifact materials. The functional "meanings" of these materials were derived from direct ethnographic and world-wide comparative evidence. The results may simply be mentioned here:

1. The habitation rooms probably served in the preparation of food, eating, the storage and use of water, and the manufacture of hunting tools. They may also have served as centers for the manufacture of pottery, ground and pecked stone implements, and ornamental items —but the latter inferences are much less than certain.
2. The storage rooms were used in the storage of plant foods (pollen evidence) and non-food items; they also apparently served as work areas.
3. The ceremonial rooms were indeed used ceremonially. They also served as centers for weaving and the manufacture of hunting tools. Ethnographic evidence suggests they may also have been male "clubhouses" or meeting places.

The centrally located plaza shows fairly clear evidence of ceremonial utilization, in that it contained a small, slab-lined "box" that seems analo-

[1] Economic plants are defined as those for which there is evidence of their introduction into the site by men rather than by natural agencies. In the present case, they include *Zea*, *Cucurbita*, *Cleome*, *Opuntia*, and several others.

[2] Seven rooms exceeded 16.0 sq. m. in floor-area; one was as large as 33.5 sq. m. The distribution did not suggest a definite third mode, however.

[3] These associations were established on the basis of a series of Chi-square tests of association. The .05 level of significance (and above) was accepted as indicating significant association.

gous to similar features in present-day pueblos. These features are used, ethnographically, to contain various ritual materials during ceremonial dances; and they are presumably symbolic of the place from which the people, according to legend, emerged from the underworld ("sipapu" or "earth navel"; Mindeleff, 1891, pp. 71, 72; Parsons, 1936, pp. 362, 438, 483). Such boxes are apparently found in all modern pueblos (Alfonso Ortiz, native of San Juan Pueblo, personal communication).

In any event, nearly all of the functions mentioned here are carried out in analogous types of rooms found among the recent Hopi and Zuni Indians.

It is significant that were it not for the pollen data recovered from nearly all rooms at the site, it would not have been possible to be sure that the storage rooms actually served in a storage capacity. The demonstration that pollen data can be used in isolating functionally specific areas within a site may represent an important methodological advancement. It may, in the future, be possible to isolate functionally different sites (and seasonally occupied sites) by this method.

Five uxorilocal residence units[1] apparently existed at Broken K Pueblo, provided that our interpretations are correct; and these can be grouped into two, more inclusive units (Fig. 106 for their locations). These units were tentatively demonstrated as follows:

1. Non-random distributions of ceramic design elements, pottery-types, firepit-types, storage pits, "chopper"-types, and animal bone indicated discrete localizations within the pueblo (which could not be explained in terms of functionally specific areas). An example of one of these distributions is given in Figure 107. A summary of all of the distributions is given in Table 6.
2. Through the use of ethnographic evidence, it was found that these items and stylistic elements were probably associated with *female* activities (except perhaps choppers and animal bone, for which there is no clear evidence). No items clearly associated with male activities were found to cluster in localized areas of the pueblo.
3. All of the female-associated items (above) were found to have been usable in the day-to-day maintenance of a residence unit.
4. Each unit was found to have had temporal continuity—at least 65 years (based on the fact that the entire occupation approximated 130 years, so that it is likely that both "halves" of the pueblo were occupied for at least half of the occupation).

[1] Uxorilocal residence is defined as a residence situation in which husband and wife live in the vicinity of the wife's maternal relatives.

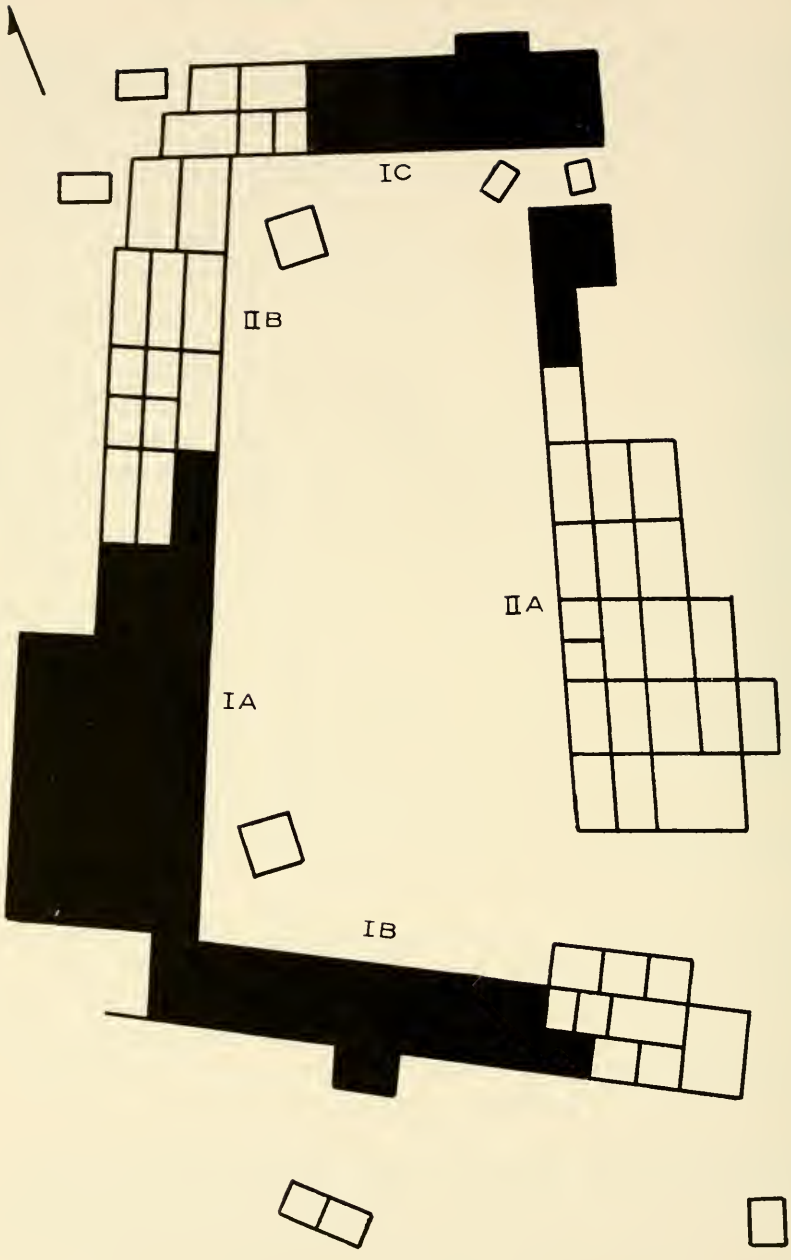

Fig. 106. The locations of residence units and their sub-units. No rooms were excavated in the east end of the south wing.

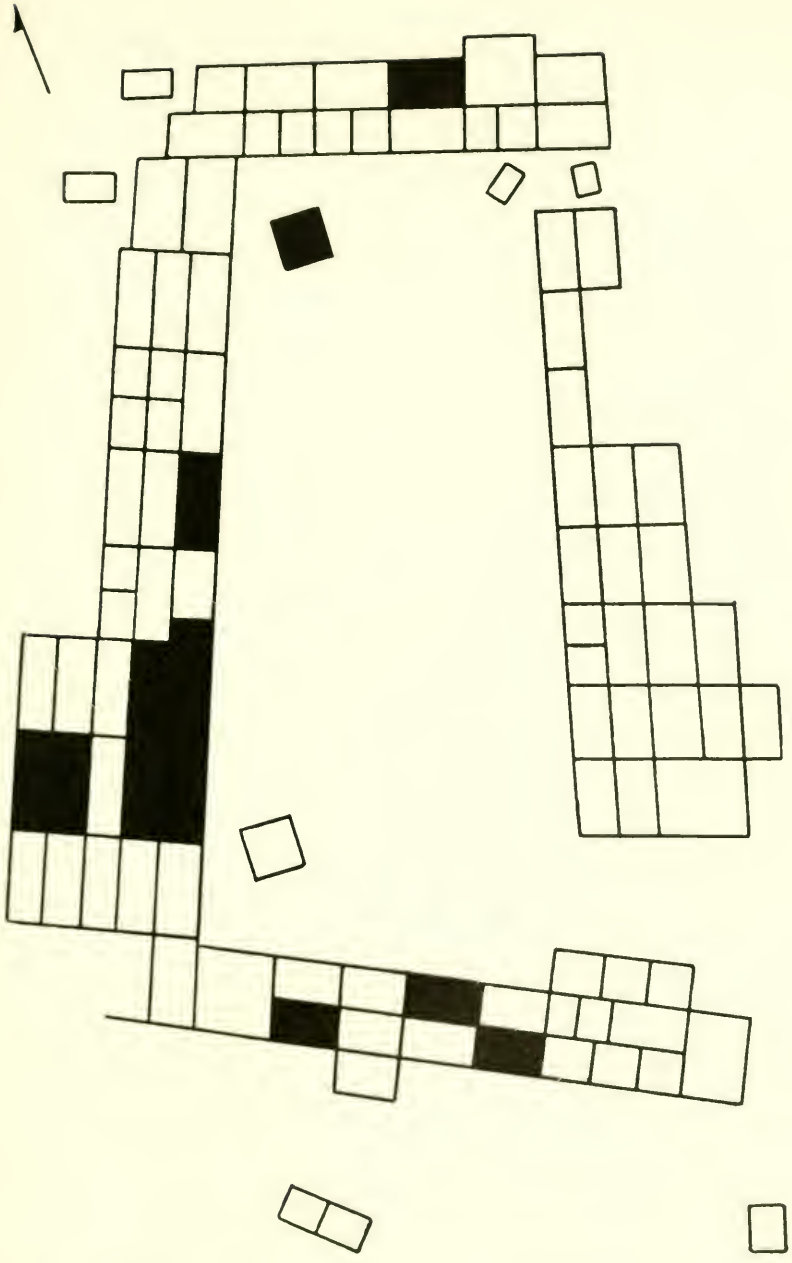

Fig. 107. Distribution of Factor Number 1 of the factor analysis of pottery types, from floors of rooms, only.

This evidence seems sufficient for the tentative establishment of the existence of uxorilocal residence units,[1] especially in the light of the fact that such units are characteristic of the recent western pueblos.

It was possible to show that these "residence units" were probably residence *groups* (rather than simple aggregates of women). This is suggested by the fact that each unit shared a number of stylistic elements not common to other units; and the distribution of ceramic design-elements in kivas suggests the possibility that each unit maintained its own kiva. This is at least true with respect to the two *large* units (Units I and II, Fig. 1).

We may also present the hypothesis that certain non-movable property was transmitted from generation to generation within each unit (rooms in this case). This is suggested by the fact that the rooms inhabited by each residence group seem to have contained the same cluster of stylistic elements throughout the occupation of the site; and this may indicate that the same group of people occupied each unit for at least 65 years. If there had been a high degree of group movement within the pueblo, the stylistic elements would presumably not have clustered as tightly as they did. If residence stability is indicated, then, it seems likely that the rooms in each case were inherited through time. This suggests the hypothesis that the groups were "corporate"[2] in some sense.

It is not possible to intimate that matrilineal descent was involved, since it is not believed possible for archaeologists to excavate descent rules (or any social rules or norms). Furthermore, social anthropologists are not even in agreement on the definitions of the various types of descent.

Upon comparing the residence units at Broken K Pueblo with those discovered at a slightly earlier site in the same valley (Carter Ranch Site; cf. Martin, Rinaldo, Longacre *et al.*, 1964*b*, and Longacre, 1963, 1964), I found that both communities had contained residence units of a very similar size (ca. 20 rooms per unit). Broken K Pueblo, however, contained over twice as many such units as did Carter Ranch site, and they formed sub-units within two much larger units (i.e., ca. 40-50 rooms per unit (Figs. 106, 107). Since the earlier site contained two small units only, it is possible that that site was, as a *whole*, equivalent to only *one* of the largest units at Broken K Pueblo. It may be that as villages increased in

[1] The first demonstration that residence patterns can be discovered by studying the distributions of ceramic design-styles was made by J. D. F. Deetz, in a Ph.D. dissertation (Deetz, 1960). This study was later published (Deetz, 1965). A subsequent study of a somewhat similar nature was made by W. A. Longacre (1963, 1964).

[2] A "corporate" group is defined here as a group of related people who co-operate economically and transmit nonmovable property within the group.

TABLE 6.—DISTRIBUTION OF STYLISTIC CATEGORIES USED IN ISOLATING THE LOCI OF RESIDENCE UNITS

Stylistic Category	Residence Units				
	IA	IB	IC	IIA	IIB
Firepits, type IV	X	X	X	X	
Factor 2, pottery-types, floors	X	X	X		
Factor 1, pottery-types, floors	X	X	X		
Factor 12, ceramic design, floors	X	X	X		
Factor 2, ceramic design, floors	X	X	X		
Storage Pits, 7–15 present	X	X	X		
Factor 13, ceramic design, floors	X	X			
Firepits, Type I	X	X			
Flake Choppers, floors	X	X			
Factor 5, ceramic design, floors	X				
Factor 4, ceramic design, fills	X				
Prairie Dog Bone, floors	X				
Factor 9, ceramic design, fills	X		X		
Factor 6, ceramic design, floors		X			
Factor 3, pottery-types, floors				X	X
Factor 4, pottery-types, floors				X	X
Factor 1, ceramic design, fills				X	X
Factor 2, ceramic design, fills				X	X
Firepits, type III				X	X
Factor 3, ceramic design, floors				X	
Factor 9, ceramic design, floors				X	
Mountain Sheep Bone, floors				X	
Gopher Bone, floors				X	
Firepits, type V		X		X	
Factor 4, ceramic design, floors					X
Factor 3, ceramic design, fills					X
Firepits, Type II					X
Storage Pits, none present					X

size through time, there was an increasing number of "large" units per village, each of which included at least two sub-units.

The modern Hopi and Zuni also have a hierarchy of social organizational units—lineages, clans, and so forth, (Eggan, 1950) It is possible that the largest units at Broken K Pueblo were equivalent to clans (or phratries), while the sub-units were equivalent to lineages (or clans). This cannot be demonstrated, of course, and perhaps it is unnecessary. It may, in the future, be possible to compare prehistoric pueblos with *one another* with respect to "equivalent" social units; and it is likely that non-puebloan sites can be compared in a similar manner.

A number of sociological and demographic changes were occurring between A.D. 1050 and 1300 in the Southwest, and they may have been promoted by a minor environmental shift. The existence of this shift is well known, and has been demonstrated by palynological, dendrochrono-

logical, and physiographic evidence (Bryan, 1925; Douglass, 1929; Hack, 1942; Schoenwetter, 1962; Hevly, 1964; Schoenwetter and Eddy, 1964; and others). One of the possible responses to it was a general decrease in population which was in full force by A.D. 1250. At about the same time, many villages were abandoned, and people appear to have aggregated into fewer but larger villages along major drainageways. These sites are not generally in "defensive" locations, and the fact that they distribute along waterways suggests the possibility that this change in settlement pattern was related to a factor in the physical environment. Perhaps water resources were a critical factor.

There may also have been an increase in the scope of inter-village integration, as indicated by the fact that "Great Kivas" became more common between A.D. 1000 and 1200 (cf. Vivian and Reiter, 1960). These kivas may have been associated with inter-village ritual institutions. Further, there is evidence of a possible broadening of the scope of intra-village integration, as suggested by the fact that the ratio of ceremonial rooms to other types of rooms became continuously smaller through time (Steward, 1937). All of these trends are noted in the vicinity of Broken K Pueblo.

In addition to the hypothesized increasing scope of integration and aggregation, however, there is direct evidence (too detailed to include here) that the people of Broken K were responding to a shift in the physical environment. This evidence suggests that agriculture was being replaced by the gathering of wild food-crops through time, and hunting was becoming extremely unproductive.

After Broken K was abandoned, the supposed processes of aggregation and integration continued, both in eastern Arizona and throughout major portions of the Southwest. By 1540, there were only a few large pueblos remaining. An examination of the ethnographic evidence indicates that the Hopi and Zuni Indians have a much wider scope of intra-village integrative mechanisms than is *apparent* at Broken K Pueblo. It seems at least a likely hypothesis that an environmental shift made subsistence so difficult that previously separate family or lineage groups were forced to aggregate for mutual support.[1] This aggregation, in turn, may have led to the development of broadened integrative mechanisms which served to bind the larger groups together (cf. Longacre, 1963, 1964). In short, it seems likely that a number of aspects of western Pueblo social organiza-

[1] As an alternative hypothesis, it might be suggested that under the environmental conditions hypothesized, the inhabitants of the area would *disperse* rather than aggregate. Still, once these people were "committed" to a stable, sedentary agricultural economy, it seems likely that they might have attempted to maintain it in the face of conditions that would probably promote dispersal among less sedentary peoples. The impression is given, in the ethnographic literature, that the Hopi and Zuni would find it difficult or impossible to revert to a strictly hunting and gathering existence.

tion can be explained in terms of adaptation to a shifting physical environment.

The interpretations offered here are hypotheses only; and as such, they may be useful. This paper does, however, present some of the ways in which archaeological data may be interpreted.

VIII. A Brief Appraisal

By Paul S. Martin

This volume is another in our series on the Pre-history of Hay Hollow Valley, eastern Arizona—from circa 3000 B.C. to A.D. 1400. The authors of the several chapters have competently covered their subjects. Paraphrasing their essays is unnecessary.

The chapters by Hill (*Sampling* and *Structure, Function, and Change*) and by Longacre (*Artifacts*) represent innovations in our archaeological reporting and in my orientation. A word, then, in explanation of this shift.

Since my intellectual life spans several decades, I can trace the history and changes in anthropological stances in my writings. Not unsurprisingly, through the years my theoretical orientation parallels that of my peers. Briefly, permit me to review the theoretical orientations that have guided them and me.

When I was a student, my professor, Fay-Cooper Cole, urged us to gather facts and to let them speak for themselves. He urged us to employ speculation sparingly. Emphasis in archaeology was on historical reconstruction.

In 1924, Kidder published his Introduction to Southwestern Archaeology. He summed up (p. 353) the relevant facts of Southwestern prehistory by means of historical reconstruction.

Strong (1935, p. 6) set forth an expanded notion of archaeology by stating: "To the writer [Strong], ethnology and archaeology, far from being isolated studies, are actually two inseparable means to an essential end—the attainment of the most complete understanding possible of human culture at all places and in all times. The more complete data of ethnology permit certain deductions concerning the past, but these can be objectively checked only when the archaeological record is known."

In *Rediscovering Illinois*, (1937) Cole and Deuel stated: "The avowed aim of archaeology is to make the past live again. It seeks to extend history beyond the written record . . . archaeology likewise tells us of the growth of cultures" (p. 1); and ". . . When . . . resemblances [of traits] were sufficiently numerous or striking, the sites were classed together as a "culture' . . ." (p. 33).

Nelson (1938, p. 146) said: "Archaeology may be defined as the science devoted to the study of the entire body of tangible relics pertaining to the origin, the antiquity, and the development of man and his culture . . . archaeology in a narrower sense is concerned with the study of the remains of human handicraft."

In 1949, Clyde Kluckhohn, a true practitioner of interdisciplinary studies, said (p. 50): "The interest of modern archaeology is focused upon helping to establish the principles of culture growth and change."

Emil W. Haury, in a paper given in Detroit in 1954, expressed astonishment at the fact that few archaeologists had tried to extract sociopolitical factors and interpretations of settlement patterns in the Southwest. He went on to say: "Obviously, what is needed is the formulation of problems and the invention of procedures for gathering and studying comparable data. This will mean a shift in emphasis from *historical* to *functional* research [italics, mine] and a more intensive dependence upon the work of the ethnologist. . . ." (Haury, 1956, p. 3).

In a mere matter of 30 years (1924-1954) then, one can trace the shift in the basic philosophy of archaeologists from an emphasis on chronological, particularistic studies cast in an historical mold to an emphasis on sociopolitical-functional researches.

From the 1890s to the 1950s, no matter where one looks, one can clearly see these changes: from Bandelier and Boas through Culin, Cole, Fewkes, Fowke, Holmes, Moore, Putnam, Uhle to Kluckhohn, Haury and most recently to Binford, Deetz, Longacre and Hill;—running the scale from history to the study of patterns of behavior and their functional significance.

But, implicit in the works of all earlier American archaeologists—like the ground bass of a Passacaglia—is the interest in description and analysis of cultures and in cultural variations. For the most part, however, a partiality for historical narration and reconstruction outweighs all other interests in explicit statements. Such orientation stressed, naturally, traits: houses, pottery, stone axes, projectile points, mortars, and so on. Unique historical events were underscored; historical accidents were invoked to explain differences and similarities. Nowhere does one find a search for laws and regularities, although the historical school claimed to be scientific. How did this tendency to dwell on culture elements arise? Why did archaeologists follow this path?

The answer is that everyone—all anthropologists, almost without exception—were wedded to the same theoretical orientation.

What were most anthropologists of the same time period doing? Let us glance at a few titles of scholarly subjects: Means, *Musical Instruments*

of the Incas; Culin, *American Indian Games;* Mason, *Aboriginal Basketry;* Sprinzin, *The Blowgun in America, Indonesia, and Oceania;* Loire, *Sun Dance of the Crow Indians;* and Gifford, *Culture Element Distributions: Apache-Pueblo.*"

The anthropologists of the time considered it their task to find the distribution and variants of each culture element. Careful analysis often permitted the scholar to reconstruct the distributions of one particular trait and trace its spread and these in turn sometimes permitted him to create a reasonable hypothesis that would explain the place of origin. For example; the use of copper, of bronze, of iron; the rise and spread of agriculture, pottery, writing, the couvade, stories of the flood, the origin and spread of the double-headed eagle; and the connections, if any, between games, such as patolli, parcheesi, string figures.

In short, everybody was doing it! Archaeologists were the products of their times and the empirical approach was popular.

What triumphs are to be credited to our predecessors! No matter what "school" they followed, many excellent, sound, necessary, and invaluable results were obtained and indeed still stand today, unchallenged. One has only to remember the brilliant work of my former teacher, Edward Sapir, (1915, 1936) in tracing Athapascan linguistic elements from Canada to parts of the United States and Mexico; or of my former scholarly chief, Berthold Laufer, in showing the interchange of culture elements between Iran and China (Laufer, 1919).

I feel humble when I recognize the achievements of the giants because without them we could not make advances nor go on to newer interests. If we hope to arrive at cultural regularities, varied approaches and multiple hypotheses (Chamberlin, 1965) are essential.

With such an array of methodologies and an accumulation of results on which to build; with the advent of recently devised statistical techniques for handling data quantitatively, and with a focus on culture as a system of inter-related variables, we are now in the happy position of being able to study cultural systems as a whole, to investigate cultural processes and the reasons for cultural changes, and to contribute to the *science* of man. Without the fullness and richness of past researches, we would be lost.

In his Detroit paper, Dr. Haury stated with great prophetic insight: ". . . . . it does appear now, with the trend toward broadened horizons that inference as to the nonmaterial aspects of archaeological groups must be as much a part of our reports as is the description of architecture and pottery. The crux of the matter is, of course, how far we can go in making such inferences and interpretations." (Haury, 1956 p. 10).

This volume is an example of some of the recently devised techniques and multiple approaches and may be a partial answer to "how far we can go."

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